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THE

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PUBLIC ELECTRIC SUPPLY SYSTEMS.

SOME days ago a prominent London Vestry found it necessary to circularise its electricity consumers to the effect that it would be under an obligation if they would use as little light as possible between the hours of 4 and 6 p.m. In other words, it was a request to be sparing with the current when it was most needed for business purposes. It would be interesting to learn the precise result of such a notice, because, without minimising matters, it is tantamount to a declaration of weakness; but though one may deplore the necessity for such a step, the position of the Vestry in question is typical of that occupied by most of the electricity supply authorities in London, whether they be local bodies or companies. One might extend this statement, and say that it practically represents the position of electricity suppliers throughout the country. That such a condition is strongly suggestive of mis-management goes without saying, but before one attempts to apportion blame in the matter, some regard ought to be paid to the entire circumstances surrounding the growth of electric lighting in this country. When electric lighting first became a commercial operation, it was prescribed by the Board of Trade that there should be a certain amount of plant entirely set aside as a standby. In those days it was thought we knew nothing of the problems connected with the supply and distribution of electricity, and as engineers and managers gained experience, they came to look upon standby plant as an unnecessary luxury, until it may be fairly affirmed that to-day the practice of using standby plant has fallen, to some extent, into desuetude. We are quite familiar with the fact that it is difficult to lay down any hard and fast lines on the subject, and we can understand, and to some extent sympathise with, the desires of a central station manager to avoid lightly loaded plant. At the same time, the most important fact, from a public point of view, is continuity of supply, and this must be maintained, even if it means jeopardising the economical running of the works. In spite of the statements concerning the high cost of electric lighting, emanating chiefly from the Welsbach Company, electricity, as an illuminant, has increased in use to a remarkable extent during the past few years. It is evident, however, that the increase of consumers has not been attended with a corresponding increase of plant. It may be that many supply systems have been "hung up" by reason of the non-delivery of electrical plant, and probably the manufacturers may be to some degree saddled with the responsibility of the present difficulties; but if we are to offer excuses, something might be urged on behalf of the contractors, who have become almost submerged in orders during the past few months. While it may not be difficult to account for the position of electric supply companies, explanations, after all, provide poor consolation for the consumer who has been, in many districts, suffering from a drop in pressure. It is probable that many of the electric lighting concerns may muddle through the winter with their present plant; but if there should happen to be a bad breakdown in any of the London stations it may mean a

serious source of loss for the consumers. Hitherto, in time of trouble, it has so happened that one company has been able to give a helping hand to another which was suffering from temporary disablement, but it is doubtful what help would now be available if any of the lighting concerns were to break down. We know that many of the responsible engineers are passing through an anxious period, and for their sakes, as well as for the well-being of the industry, we trust that they may be able to steer clear of difficulties; but in the event of a discontinuity of supply, electric systems might be saddled with restrictions which would probably press somewhat severely upon them. There is a very praiseworthy desire on the part of the managers of electricity undertakings to bring down their costs of production to a record figure, but we are afraid that the race for records would not encourage the adoption of spare plant. Continuity of supply is as important as, if not of greater importance than, efficiency, and in future there ought to be more regard paid to this matter.

One of our engineering contemporaries has recently treated this subject in a very able manner, and while in the main we are disposed to agree with its remarks, we think that on some points it somewhat overstates the case. It seeks to lay the blame, of being unable to meet the demand, at the door of managers and secretaries of electric lighting companies; but then, are the supplies conducted by local authorities any better off than those which are managed by managers and secretaries? Moreover, it is doubtful whether any ordinary business man who was managing an electric lighting concern would act without reference to his engineer. There is, we admit, a great difficulty in refusing custom, and we are afraid lighting authorities have added consumers in the hope that things would eventually come right, though they were perfectly cognisant that their present plant would not cope with sudden rushes. A policy of grab is, moreover, being adopted by some companies. They are not content with endeavouring to keep up the volts in their own district, but they must covet some other area which has been already exploited by another concern. Before extending its sphere of operation, a company ought to properly develop what lies to hand. Fortunately, the reckless connection of lamps has practically ceased, and, with luck, the demand may be met.

Amid the tremendous boom in all electrical matters, one is forcibly struck with the utter inadequacy of the London electricity works to meet anything like the probable demand; that has been recognised very fully by some of the greater concerns; and hence we see companies like the Metropolitan erecting huge buildings outside London, and transmitting current at high voltage to various sub-stations. Even a company like the Kensington and Knightsbridge, a noted adherent of the direct current system, is compelled to remove its generating machinery outside its area of supply, and utilise a two or three-phase system for the transmission part of the scheme. Apart from the question of overloading from which most works are suffering at the moment, one feels a little uneasy at the numerous breakdowns which have dislocated many public services of late. In the absence of extensive storage comparable with that of gas, we must expect interruptions to the public supply of electricity if there is not proper provision made in the way of spare plant. Sooner or later all running machinery will go wrong, but what we have recently witnessed in some electric systems is that if one part of the machinery goes wrong it is so frequently followed by the dislocation of other machines. It is difficult to see why this should happen, unless there is some inherently bad arrangement of the electric or mechanical details of the system. Unfortunately there are many works in this position, and their defects can only be repaired by a complete abandonment of the system. The difficulties of an electric supply are many, and they are not likely to be lessened by endeavouring to meet large demands with a minimum of plant.

A WORD TO MANUFACTURERS.

While English electrical manufacturing works are making extension upon extension, American works which have been doing so for years past are continuing to develop in the same way. The foreign trade of America is very largely responsible for this, while our own works find it difficult to meet, with reasonable promptitude, even the requirements of our home progress. Not that English electrical engineers are slow to canvass for the wants of foreign countries and the Colonies, for an enormous trade is being done in that direction; in fact, it is just possible that the foreign trade sometimes gets in the way of the execution of home orders, the capacity of works not yet being equal to the double demand. On the other hand, we have to admit that for obvious reasons American manufacturers are in a very favourable position for meeting both demands without their clashing. English works, by the extensions of the last few years, have been preparing to better meet the wants of the world's markets, but there is to some minds a question as to whether the rate of carrying out extensions has been so great as has the further development of electrical engineering in all its branches at home and abroad. We believe that the development has been, and is now, proceeding at a pace which has exceeded expectations, notwithstanding the fact that we witnessed American progress of the same kind, but upon a more insecure basis in some respects, years ago.

There are certain branches of manufacturing for which we are still dependent upon the States. Whether such need be the case we may have our doubts; but certainly, while we are bringing about the too long delayed works development, our American competitors may be reasonably allowed to share in the spoil. We believe we are right in saying that the recent steps taken by certain large manufacturers in the States in building works on this side of the Atlantic will, perforce, be followed by others of their American rivals; and we cannot feel that American or any other competition on these lines is to be objected to, where the capital and labour are British, and the management and works control are in the hands of American experts. There will, we feel, be plenty for all to do, and one effect will be to provide a number of object lessons for any ultra-conservative home works—if there be such; although there is a chance that it may be too late then to profit by such lessons. Another effect, however, should not be lost sight of; when American manufacturers have, with our financial and labour co-operation, established their works on this side, their States' factories will no longer be occupying themselves with the manufacture of installation or traction plant for this country. This will leave them freer still for extending their foreign connection, and will render Anglo-American rivalry on foreign soil keener than ever. It would thus seem that all the consequences of our backwardness have not yet made themselves felt.

Lord Charles Beresford has drawn attention to the great future that ought to be in store for English engineers in China. An esteemed contemporary, in this connection, remarks: "Where is the need to go to China, when our manufacturers are beaten by foreign makers, not only in our Colonies and dependencies, but also in our own country?" This kind of argument may commend itself to others, but we are inclined to think that to advocate this new policy is at once ill-advised and short-sighted.

Our American rivals have already planted themselves more or less firmly in the East, and while we quibble as to the wisdom or folly of expanding our electrical trade there, they are making their connection still more firmly established, and are carrying out orders and equipping electrical systems. British prestige may count for something, but there is a great deal in being first in the field. Possibly the real meaning underlying our contemporary's remarks is that home trade should not be allowed to suffer because of increased attention to foreign development. With this we agree, and all attempts to impress upon our manufacturers the necessity of shaking themselves free from the orthodox and hypercautious bands which have hitherto bound them, to the detriment of their own interests and of the welfare of national industry, are worthy of all the support it is possible to accord to them.

But rather than suggest staying a hand anywhere, we would advise the putting forth of a double or treble effort everywhere, and with discretion to energetically strive to recover at least some of the lost ground.

SOME NOTES ON ROTARY CONVERTERS, WITH SPECIAL REFERENCE TO THE EXTENSION PLANT OF THE CHICAGO EDISON COMPANY.

By A. C. EBORALL.

(*Continued from page* 872.)

In addition to its principal use of serving as a connecting link between the high tension polyphase transmission lines and the low tension direct current distributing system, a rotary converter can be employed in other ways, for instance, to convert direct current into polyphase current. It sometimes happens that a direct current station desires to supply power to a point or locality quite outside its own sphere, and, in order to do this, some form of high pressure alternating current must be employed, if due regard to economy is to be paid. Either, then, a special unit must be put down, generating high tension single or polyphase current, preferably the latter, or use may be made of a rotary converter running as a direct current motor, and generating low pressure polyphase current, this being transformed up to a suitable value for the line. It will be found that the latter method is the better of the two, both with regard to first cost and to cost of running, if the amount of power to be transmitted to the outlying district is a definite quantity, and not likely to increase with time. On the other hand, if the demand is likely to grow, it is better to put down a separate unit. The reason for this is, because it is a most difficult thing to get rotary converters to run properly in parallel when running as motors from the direct current side; in fact, it is practically impossible, especially if the load consists partly or wholly of motors. Consider what happens for the case of a single rotary running under these conditions. The speed depends upon the direct current pressure supplied to it, which would be constant, and to the strength of the field system. At full load the field excitation will be adjusted to the correct value, and the speed of the rotary will be normal. Now, suppose the load on the motors deriving current from the rotary is reduced, or removed altogether, which would have the effect of greatly diminishing the power factor of the line. With diminished power factor, the reaction of the armature current upon the field magnets will greatly increase, weakening the latter, and causing the speed to go up, and under some circumstances it might quite well happen that the machine would race. In order to prevent such an occurrence, it is usual to fit a centrifugal device to rotaries used in this way, which will either cut out the machine altogether, if the speed exceeds a certain value, or will actuate a field regulator, and strengthen the field as the speed increases, but, of course, the latter means can only be used within very narrow limits.

It will now be clear that the operation of rotaries in parallel, when driven from their direct current sides, presents formidable difficulties, and consequently, as far as the writer knows, is never attempted in practice. It might be possible to do it successfully if an independent power-driven alternator was arranged to run in parallel with them, in order to fix the speed. In this case the centrifugal governors could be dispensed with, as the alternator would set and maintain the speed, but it is obvious that it would pay better, under these conditions, to dispense with the rotaries altogether; so that, for the case cited above, should it appear that extensions will be required, it would be far better to instal independent power-driven generators.

An instance in which a single rotary converter is used with great success to convert direct current into three-phase current may be cited by the writer. A certain small district in the south of Switzerland, having watchmaking as its main industry, was supplied with current for motive power purposes from a central power house generating direct current for several neighbouring districts. It was found that the direct current motors in the various workshops so affected the springs of the watches, that their employment became out of the question. The difficulty was completely solved by placing a sub-station in the district, and installing therein a rotary converter, which takes in direct current from the power mains, and furnishes polyphase current to the various workshops for driving three-phase motors. This incidentally brings in another advantage—the three-phase motors are considerably cheaper than the direct-current motors—a great point for small industrial work of this character.

Rotary converters, when driven by power, may also be successfully used as double-current machines, that is, they may be used to generate either direct current, or polyphase current, or both simultaneously. This may be an advantage in certain special cases, but if the machine has to furnish both currents at the same time, it must be not only carefully designed for the purpose, but great care must be taken with the connections, if several units are to be operated in parallel.

As far as the writer knows, the first use of "driven rotaries" as double-current machines was made by Messrs. Ganz & Co., of Buda-Pesth, some three years ago, in the installation put in by that firm at the works of the Danube Steam Navigation Company.

The workshops of this company are distributed over a length of about 1½ miles along one bank of the river, and are driven and lighted electrically, three-phase motors taking

Fig. 1.

the place of the steam engines previously in use. As it was deemed advisable to retain the old shafting and arrangements, the speed of the motors had to be evaluated in accordance with this, motors of 1 H.P., for instance, having to run at a speed not exceeding 450 revolutions per minute. To obtain these low motor speeds economically, it became necessary to reduce the frequency of the three-phase currents supplying them to about 15 cycles per second—a frequency much too low for lighting purposes. Consequently, driven rotaries were installed, and these furnish direct current for lighting and three-phase current for the motors. A few details of the installation may be of interest.

In the power house are three direct coupled sets, two of 200-KW. each, and one of 100-KW., the engines being of the triple expansion marine type, running at 150 revolutions per minute for the larger generators, and a compound engine running at 225 revolutions per minute for the 100-KW. generator. The direct current lighting circuits (which, however, also supply six motors) are arranged on the three-wire

system, with 290 volts between the outers, and are regulated for constant pressure. The three-phase circuits, supplying 48 motors varying in size from 1 to 50 H.P., are two in number, and are fed from the three-phase sides of the generators, which are not arranged, as far as the writer knows, to work in parallel. As the load on the three-phase circuits consists entirely of motors, it is not necessary to regulate the pressure, which varies within narrow limits according to the load.

Another installation, employing driven rotaries, and offering many points of great interest to the designers of central stations, has recently been completed and set to work for the Chicago Edison Company. The writer is indebted to the *American Electrician* for most of the details of this plant given below, and would refer those further interested in the subject to the current number of that journal for an excellent general description of the plant and its arrangements, switch gear, &c.

The central station of the Chicago Edison Company was originally laid down as a direct current station on the three-wire system, with about 120 volts between the neutral and each outside conductor. The city, however, extended so greatly, that the company found themselves called upon to supply current to an up-town district 3½ miles away. In order to cope with this distant demand, a three-phase 250-KW. rotary converter was installed in the station, arranged to run from the direct current bus bars as a motor, thus furnishing three-phase current at a reduced pressure. This was stepped up in the station to 4,500 volts, and sent over high pressure lines to a sub-station in the distant district, and there transformed down again, and fed into a three-wire direct current network by means of two 100-KW. rotaries connected on the direct current side.

But the demand in the up-town district grew so rapidly, that it soon became necessary to increase the capacity of the sub-station, and it is this extension plant that will be now described.

On account of the difficulty, already pointed out, of running rotaries in parallel when they are supplied by direct current, it was not deemed advisable to add other rotaries to the power station. And here an important point came in—the peak of the load in the up-town district occurred considerably later in the day than that in the district directly fed by the power station with continuous current. For this reason, instead of putting down three-phase generators to feed the up-town district, it was deemed expedient to instal driven rotaries, or double current generators, which could feed either the up-town sub-station with high pressure three-phase current, or the adjacent districts with direct current, or both simultaneously.

The double-current generators now installed are four in number, arranged in two pairs, each pair being driven by a 600-H.P. triple expansion condensing vertical engine, running at 150 revolutions per minute, the generators being directly connected to each end of the crankshaft. The general appearance of the generators is shown in fig. 1; each is of 200 KW. capacity (either as direct or three-phase current), and has 20 poles, giving a frequency, at the above speed, of 25 cycles per second. The commutator is mounted upon a cup-shaped spider, and is about 5 feet in diameter; the current is collected from it by means of 20 sets of block carbon brushes, arranged to be simultaneously adjusted by means of a hand-wheel. Within the commutator spider are three heavy collecting rings, from which current may be taken by means of 12 tangential copper brushes pressing on each ring.

The two generators forming a set have their direct current sides connected in series to feed the three-wire direct current network at 240 volts between the outers; the three-phase 80-volt sides of each generator may be connected together in parallel in the manner presently to be described, and in parallel with the rotary converter already referred to. The two sets of one engine and two direct connected generators are numbered No. 12 and No. 16 respectively.

Fig. 2 shows the switchboard circuits for *one* of the sets, namely, No. 12. The direct current sides of each generator feed into the bus bars (having 120 volts between the neutral and each of the two outers) shown at the top of the diagram, the fields of each being excited at 120 volts, and being provided with a switch and high resistance, in order that the field current may be broken without danger, if necessary. From the three slip rings of each generator, the three-phase currents are led to the terminals of an "induction regulator," whose purpose is to regulate the pressure on this side without altering the excitation, as this is adjusted to give the proper direct current pressure. The induction regulators are not in the immediate neighbourhood of the switchboard, but are nevertheless operated from it, in a manner to be described later. From the regulator the current passes to three single-pole switches, by means of which the two machines on one engine may be thrown together on the polyphase end, or disconnected from each other, or from the line. From these switches the current passes to six fuse blocks, which form the secondary terminals of three 150-KW. step-up transformers. Each of these transformers has two secondary (80-volt) windings, quite independent of one another, one winding belonging to one phase of the first generator, the second winding belonging to the corresponding phase of the second generator. This arrangement of a double low pressure winding per transformer is absolutely

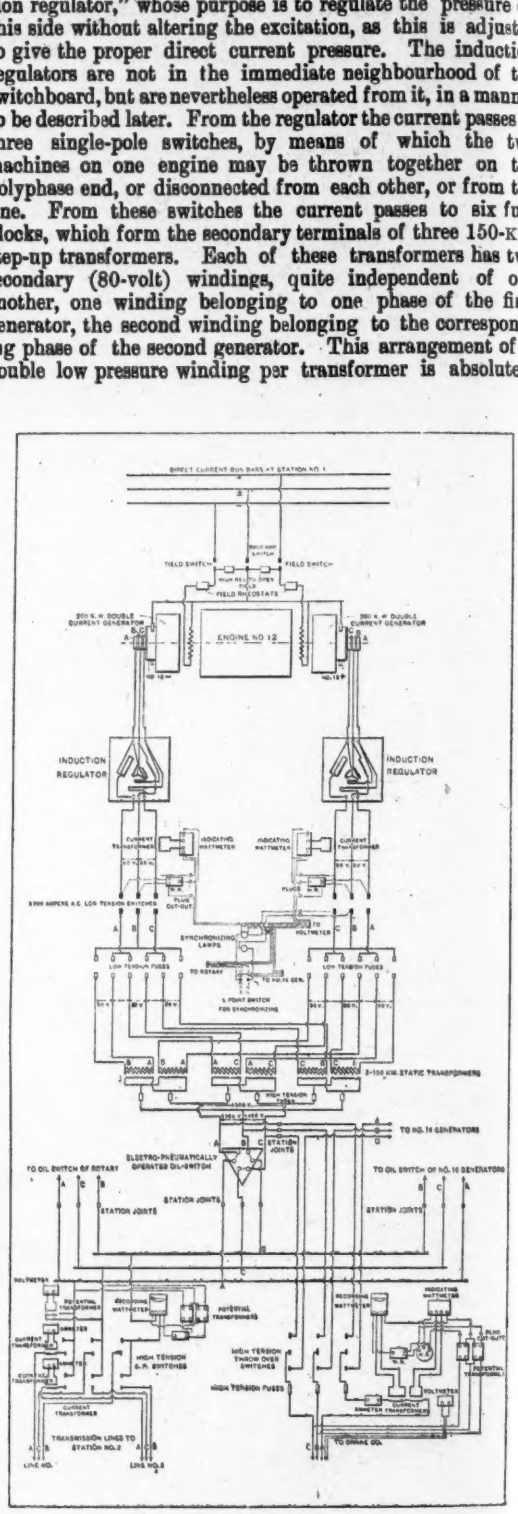


Fig. 2.

necessary, as the two generators of each set have to run in parallel; the three-phase sides cannot be directly joined, owing to the machines being already connected on their direct current side—if they were directly connected, a bad short circuit would, of course, result. The reason for providing each main conductor coming from the induction regulator with two fuse blocks is in order to give each of the three low pressure transformer windings, which are mesh connected, a fuse of its own at each of its terminals, so that if one transformer winding gives out, the other two will

remain working, which would not be the case if there were only three fuses, one for each main conductor.

Each transformer has two high pressure windings, which can be connected in parallel or series, giving a potential of either 4,500 or 9,000 volts. At present 4,500 volts is used. The high pressure leads of the transformers are taken to six high pressure fuses of the "expulsion" type, and then away to the high pressure three-phase bus bars through a pneumatically operated triple-pole oil switch. But on the transformer side of this switch, a tapping is taken off each conductor to a separate switchboard, shown at the bottom right-hand corner of fig. 2. This board controls the supply of current to a single distant consumer, the Crane Company, to whom current is supplied in large quantities for power purposes. A triple-pole throw-over switch enables the Crane Company to be supplied with current from either of the sets, independently of the station high pressure bus bars; this consumer can be connected, in fact, directly to the high pressure terminals of either of the sets by means of his own switch gear, the actual connections being clearly seen from the figure.

From the high pressure bus bars in the power station the current is taken by means of two distinct three-phase feeder cables to the up-town sub-station. The feeder panel for these transmission lines is shown in the left-hand bottom corner of fig. 2, which gives the connections of the measuring instruments, single-pole high tension switches, &c. The synchronising arrangements for putting any of the four generators in parallel with themselves or with the rotary, are of the usual character, one phase being synchronised, and are shown in the centre of fig. 2. It will be noticed that the current coils of the wattmeters indicating the output of each of the machines are not in series with the main conductors, but are supplied indirectly through small series transformers connected into each main conductor. This is because the transformers are located at some little distance from the switchboard, and it would be obviously absurd to carry the heavy cables specially to the switchboard for such a purpose.

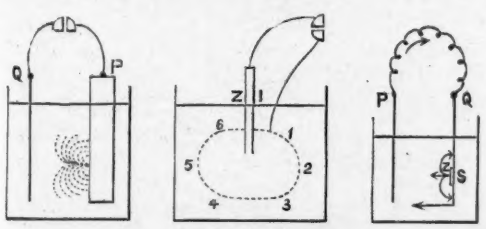
(To be continued.)

SOME EXPERIMENTS ON VOLTAIC CELLS WITH COMPOUND ELECTRODES.

By FREDERICK S. SPIERS, B.Sc.

(Concluded from page 912.)

6. To test this suggested explanation, a zinc-iron (Z I) couple, connected as shown (fig. 8), was suspended in the middle of a large glass breaker, so that a particular stream line of current followed approximately the course of the dotted line; and the potential at various points along that



Figs. 7, 8 and 9.

line was explored by means of the projecting tip of a brass wire that was sealed in a glass tube. Readings were taken with the brass tip at each of the six points marked.

Position	(1)	P.D. between couple and brass point	=	0·59	volt.
"	(2)	" " "	=	0·70	"
"	(3)	" " "	=	0·73	"
"	(4)	" " "	=	0·78	"
"	(5)	" " "	=	0·85	"
"	(6)	" " "	=	0·90	"

The E.M.F. of the brass-iron couple alone was 0·45 volt.
" brass-zinc " 0·94 "

The results were approximately the same, whether the plates forming the couple were connected inside or outside the liquid. When, however, the plates were connected outside the liquid, through a resistance of 10,000 ohms, the effect depended upon the plate to which the electrometer-quadrant was connected. In table (*a*) the connection was with the zinc, in (*b*) from the iron.

Position.	Table (*a*).	Table (*b*).
(1)	P.D = 0·88 volt.	P.D. = 0·45 volt (= brass-iron E.M.F.)
(2)	" = 0·90 "	" = 0·50 "
(3)	" = 0·90 "	" = 0·50 "
(4)	" = 0·92 "	" = 0·52 "
(5)	" = 0·94 "	" = 0·53 "
(6)	" = 0·95 " (= brass-zinc E.M.F.)	" = 0·53 "

This is as would be expected if the explanation given here is true, for in this latter case, when the 10,000 ohms was in circuit, the chief drop of potential in that local circuit is outside the liquid, so that the modification of potential, due to the current stream lines in the liquid, is very slight. Hence, in case (*a*), the electrometer reading is that of a zinc-brass couple, and in case (*b*) that of a brass-iron couple, both but slightly modified to the same extent by the stream line change of potential, and the extreme difference in each set of figures is therefore about the same, being 0·07 volt and 0·05 volt respectively.

7. The application of the above results is of some assistance in making clear the exact manner in which the presence of zinc in boilers, in metallic and liquid connection with the steel plates, diminishes the corrosion of the latter. This corrosion, in general, is due to the current of electricity which passes from the steel to any of the boiler fittings to which steel is electro-positive, usually brass. The conditions may be represented diagrammatically by fig. 9, where Z is a small piece of zinc attached to a large plate of steel, S and B a plate of brass metallically connected to S. In this cell there are three currents flowing from the zinc through the liquid to the steel, from the zinc to the brass, and from the steel to the brass. At first thought one would expect that these currents would be totally independent of one another, thus, that the presence of the zinc would not affect the value of the steel-brass current which flowed before the zinc was introduced, and hence that the same quantity of steel would be dissolved in both cases. Of course, the *distribution* (in the liquid) of this steel-brass current one might expect to be influenced by the presence of the zinc; for at every point where the zinc-steel current enters the steel from the liquid, hydrogen is deposited, hence at those points there would be no supply of oxygen to keep up the steel-brass current, and consequently it would be reasonable to suppose that this steel-brass current would be repelled from the neighbourhood of the zinc, and would leave the steel at points far removed from, or behind, the zinc plate. The total value of this current, however, one would not expect to be affected by the zinc, for it depends merely on the potentials of the brass and steel (resistances being supposed equal in the two cases). However, from the experiments described above in Section 4 (*a*) and (*b*) we deduce that the effect of the zinc plate will be to increase somewhat the P.D. between P and Q, so that a larger current will now flow from P to Q than would if the steel plate alone were present. This is equivalent to saying that the effect of the zinc is to *raise* the potential of the point, P, and, therefore, that of the whole brass plate, B, relatively to the point, Q, and thus to the whole steel plate, S. The consequence is that the brass plate is relatively more electro-positive than it was before, hence less current will flow through the liquid from S to B, and less steel will be dissolved.

8. Some engineers seem to have very vague ideas as to the actual way in which the presence of zinc prevents corrosion in boilers. Many think that the local current it produces is merely valuable indirectly, as it tends to purify the water from acids and such like impurities. Others believe that the zinc is beneficial directly by its influencing the potential of the various components of the boiler. (See Ewing's "Steam Engine and other Heat Engines," Section 215.) Both hypotheses may be true; the results arrived at here certainly confirm the latter supposition.

THE POSITION OF THE ELECTRICAL HEATING INDUSTRY IN THIS COUNTRY.

The application of electrical energy for heating and culinary purposes has not made as much progress in this country as was expected of it some five or six years ago. It is therefore interesting to look into the matter, and see why this has not been the case, and further to ascertain whether a heating load, which was so strongly advocated about five years ago, as a possible means of improving the central station load factor, is still a desirable acquisition from the central station engineer's point of view.

One reason for the slow introduction of this class of apparatus into everyday use has undoubtedly been the fact that, until comparatively recently, both the electrical supply authorities and the wiring contractors have not considered it desirable to push the matter. They have looked upon any kind of heating by electricity as expensive, and likely to bring them trouble, and without going much further into the matter, have condemned it as such.

It is intended to show in the following article that whilst certain applications of electrical heating are undoubtedly expensive and extravagant, there are others which are not so, and which can be applied in such a way that any slight additional cost in working is more than counterbalanced by the advantages accruing from its use.

Each different application has to be judged upon its own merits, and whilst in some cases gas or other fuels may be found cheaper, in other cases, with different conditions prevailing, electricity will be found the cheaper.

It cannot be expected that, cost for cost, electricity will often be found a cheaper fuel than its rivals, but, when other advantages are taken into account, it can often be shown that the general savings to be made by adopting electricity are not to be despised.

The chief points to be taken into consideration in deciding whether to adopt electricity for heating or cooking purposes are the following:—

1. Cost of electrical energy available.
2. Commercial value of certain advantages which are only obtainable by adopting the electrical system, advantages such as cleanliness, simplicity, ease of working and manipulation, absence of dirt, &c.
3. In the case of private installations, whether it can be arranged to utilise the generating plant for heating purposes during those hours when it is not required for other purposes.

It is quite impossible to fix definitely the value of the advantages attending the use of electrical heating apparatus for manufacturing and commercial purposes, as these values are entirely dependent upon local circumstances; but it is intended to explain, as far as possible, the every-day uses to which electrical heating apparatus, already on the market, can be advantageously applied.

The application of these articles can be conveniently divided into three classes:—

1. Apparatus for use in manufacturing and industrial undertakings.
2. Apparatus for use for domestic purposes, either for heating or cooking—the apparatus performing the *sole* function of carrying on those operations.
3. Apparatus for use for domestic purposes, either for heating or cooking purposes; the apparatus being used as a supplement to the existing systems.

Taking the case of the manufacturing and industrial undertakings first, we have the following among the common applications:—

I. (*a*) *Flat irons* for laundry purposes. In addition to the ordinary laundry requirements, these irons are being used to a considerable extent for finishing off dresses, blouses, &c., in dye works. The advantages of electric irons for work of this description must be apparent to everyone, especially for purposes of finishing off dresses, blouses, &c., which are often of a very delicate and expensive nature, and where cleanliness and perfect control over the heat of the iron are of first importance.

The writer knows of an installation of nearly 200 irons, which have been used for this special purpose, and which have amply confirmed the opinion that the general cost of working is less than with similar gas irons.

The chief advantages found with these irons are the following:—

1. Always ready for use, and no waiting or going away to fetch a heated iron.
2. Very clean; in the case of gas irons, very often a dress, which has been thoroughly cleaned, and is being ironed for the last operation, gets a smut of dirt on it from the gas iron, which necessitates its being recleaned.
3. On account of these points, the work turned out by the factory hands, when using electric irons, is in excess of the work turned out when using gas irons, and the piece work rate can consequently be dropped.

It is difficult to arrange two degrees of heat in one iron, and consequently the irons are made up in two degrees of heat, 300 watts and 500 watts. The higher heating iron is liable to give trouble, if not switched off almost immediately when out of use, so, whenever possible, the lower heating iron should be adopted.

Stands have been made, with switches embodied in them, so that, when the iron is placed on the stand, the current is either entirely cut off or reduced through a resistance.

(*b*) *Electrically-heated Rolls* for laundry use:—Experience has shown that the heat from an electrically-heated laundry roll can be controlled to such a nicety, that the advantages in favour of using them are very great, and, when once installed, they continue to give satisfaction. Any of the rolls used in laundry work can be adapted for electric heating.

(*c*) *Goffering Iron Heaters* for heating the ordinary goffering iron, large numbers of which are used in laundries, dye works, &c.

These heaters consist simply of an electrically-heated tube, into which the goffering irons to be heated are placed. They are found very convenient, as they can stand on the workman's bench, without any risks from fire, and are always ready for use.

(*d*) *Hot plates and Glue pots* for woodworkers' shops; also for printers and bookbinders.

Of all the advantages, perhaps the chief point in favour of electricity for heating this class of apparatus is safety, from a fire insurance point of view.

The insurance premiums for any naked lights in a carpenter's shop, as also in a printer's and bookbinder's, are very high indeed, and these premiums can be saved very largely by the adoption of some electrical means of heating.

The hot plates and stoves used for heating printers' tools are also subject to this advantage, for they have usually to stand in the midst of paper and books.

(*e*) *Hot plates and Stoves* for lacquering purposes. These are coming into very general use, for it is found that, power for power, they consume less energy than the ordinary gas jet playing on to a steel plate.

A small current will suffice to keep a plate at lacquering temperature.

(*f*) *Goose Irons for Tailors' Use.* Numbers of these are being used by tailors, and by some of the large tailoring houses; the chief advantage in using them being the fact that they are always ready for use, and that a workman has not to leave his bench to go and get his iron reheated. The iron also keeps at a uniform temperature, whilst the old type of iron starts usually too hot, and finishes off too cold.

The gas iron is, of course, not open to these objections, but fire insurance risks come in here, and this, together with the necessary exhaust for carrying off the burnt gas, tends to give electricity the favour.

These are among the chief applications on a commercial scale, though many similar uses may be found to suit special circumstances.

It may be taken as a general rule that, if the degree of temperature required for an operation exceeds 500° F., there will be difficulty in making the apparatus durable and satisfactory for general working, though anything up to this point can be heated electrically as easily as by any other means.

Whether it is going to pay to do so, cost for cost, depends upon special circumstances, and each case has to be judged on its own merits.

II. The second class, namely, that in which the heating and cooking apparatus performs the sole function of carrying on these operations, can be dismissed in a few words. With current available at 1d. or 1½d. per unit, the cost of heating one's house or cooking one's meals throughout will not be

excessive, provided some other means is adopted of heating the large quantities of water usually required for domestic purposes, such as for washing up, supplying baths, &c., which cannot easily be dealt with electrically.

The water for use in the saucepans, kettles, &c., would thus be drawn from the hot water supply, and would save a good deal of time, as these utensils cannot easily be wound for boiling up cold water quickly.

In the case of a complete cooking plant, the fact should, however, not be overlooked that the utensils are most of them liable to break down occasionally without any apparent reason, and this must be guarded against, by having a small supply of spare parts for use in cases of emergency of this description.

Provided this precaution is adopted, and provided power is available at the figure mentioned above, the use of a heating or cooking plant can be relied upon to give satisfaction, both as regards results and cost of working.

(To be continued.)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The adjourned discussion on Mr. Holliday's and Mr. Crompton's papers was resumed at the meeting of the Institution of Electrical Engineers last week. Mr. Crompton added some particulars to his paper regarding the actual result of using cheap fuel under water-tube boilers. A careful trial recently made at Glasgow showed that the figures given in the paper were closely corroborated, although the losses were not brought quite so low as anticipated, and he did not despair in getting to the figures given in the paper, but to do so the setting of the boilers must be such as to reduce the existing very considerable radiation losses.

Some figures sent by Mr. Dickinson, of the Leeds station, were read. The Leeds station started in 1893, using slack coal at 7s. per ton, but in 1894, smudge, costing only 2s. 3d., was substituted. The price has, however, been gradually rising, and now it is found economical to return to slack. Different classes of smudge were tested, and the letter from Mr. Dickinson gave the calorific values and the financial results. He remarked that cheap fuels deteriorate very much by keeping in stock; thus, one sample having an initial value of 12,000 B.T.U. fell in six months to 7,700 odd B.T.U. The smudge generally used had a calorific value of from 9,766 to 9,428 B.T.U. per lb., with from 21 to 23 per cent. of incombustible matter, while special grades of cheap fuel had as much as 12,000 B.T.U. per lb. with 10 per cent. incombustible.

Prof. Perry congratulated the Institution upon having these papers presented to them as electrical engineers. Electrical engineers deal in and sell energy, and he thought economy of fuel was more important to them than to other engineers. In this country there are few waterfalls and cheap coal, and therefore the conditions are very different to the country so many of them visited a few months ago. He welcomed any paper giving actual figures, and agreed with Mr. Crompton in his remarks on furnaces in general. Theoretical notions are coming gradually to the front. At first they are usually presented in an incomplete form, and practical engineers complete them by carrying them out. He referred to Thornycroft's fire-brick lined combustion chamber, and pointed out that the heating surface is not the only important matter, but something analogous to the "hydraulic mean depth" of the water engineer. The surfaces to be heated must be scrubbed by the gases so as to convey the heat to the metal, and the water should scrub the inside of the plate or circulate so as to utilise the heat. In the old days of low pressure steam was not very dense; now, owing to the use of higher pressures, it is dense per pound of evaporation, and one wants something of the nature of a mechanical scrubber in the water of a boiler. Another difficulty in modern boilers is airless water, and a modern chemist had told him that airless water cannot be boiled; but of course one knows from practice it does boil. He noticed that in Mr. Holliday's case a very high load factor was the ruling condition, and pointed out that the load factor on a plant is very important. He had worked out some figures in the endeavour to compare Mr. Crompton's and Mr. Holliday's total costs, and no doubt when the printed discussion appears these will prove interesting, but as given it was not quite clear how they had been obtained or exactly upon what basis the comparison was made.

Prof. Perry's figures, as tabulated, are given below. They show the prices per unit generated with different load factors and varying cost per ton of coal:—

	Total cost of evaporation, Columns T. Cost of coal only, Columns C. Cost per electrical unit. Cost of coal per ton.											
Load factor in per cent.	8s. 6d.		5s. 4d.		7s. 6d.		10s. 6d.		14s. 6d.		17s. 5d.	
	T	C	T	C	T	C	T	C	T	C	T	C
10	1·71	·20	1·66	·29	1·62	·36	1·56	·45	1·52	·54	1·49	·60
18	·73	·14	·73	·19	·74	·25	·76	·31	·75	·37	·76	·41
33	·35	·10	·37	·14	·39	·18	·42	·23	·44	·28	·45	·30
66	·19	·08	·21	·11	·23	·14	·26	·18	·28	·21	·30	·24

Mr. Shoolbred referred to the almost ideal conditions of steady load under which the figures in Mr. Holliday's paper were obtained, and directed attention to the not so ideal circumstances under which electric light stations are worked. Some slack coals, although small, have very high calorific values, and low-priced coals are sometimes really cheaper than higher grades, as calorific value does not fall as rapidly as market value.

Mr. Horace L. P. Boot, of Tunbridge Wells, regretted that engineers had not made more public the results obtained in the past few years. He had been permitted to make experiments with different classes of coal, and gave, amongst others, the following comparative results:—

Nixon	1·02d.	Cost per unit generated of coal only in same boilers. Coke at 15s. per ton.
Ocean	·96d.	
Wayne's Merthyr ...	1·20d.	
Coke	·879d.	
Great Western	·810d.	

He remarked that the cost of fuel varies largely in different towns owing to the railway rate, and that it is obviously desirable, when that is high, to use the best class of fuel possible, because a fuel costing about 5s. at the pit may be charged 16s. or 17s. per ton at the works. Another advantage is, that with high grade fuels there is a smaller outlay on boilers; less ash or clinker to dispose of; one stoker may do work otherwise requiring two, and unloading costs less. A total difference due to these causes of ·184d. may be found. He had made some observations upon the deterioration of coal by storage, and found that one month's keeping might mean a loss of 25 per cent., and with 2½ months of 33 per cent. in the case of a particular coal. The effect of bad water on the cost of coal may be very serious, but the supposed disadvantages of tubular boilers had not been felt in any single instance at his works.

Mr. Geipel thought it was an appropriate time of year to discuss questions of steam raising, and stated that Prof. Perry had anticipated some of his remarks. Few engineers were fortunate enough to come across an almost constant load factor. Of the other factors than coal, he considered the number of boilers put down to produce steam had a very important bearing on costs. The more work there is for the boiler to do the better results obtained, and Mr. Holliday's figures went to prove this. He had, however, no such difficulty as raising steam daily for three or four hours, and it was in such cases that the Babcock-Wilcox boiler was important. Lancashire boilers are very costly to "raise" steam. The difficulty of circulation might be got rid of or met by mechanical circulation, and he showed a method of his own which consisted in fixing to the lower side of the flue a tee iron projecting downwards which carried heat down into the cold stagnant water and set up an induced circulation. In 25 minutes in a laboratory apparatus the water rose 25° F. without the rib and 115° F. with the rib.

Having made one or two remarks upon mechanical stokers and the boilers at Frankfort, Mr. Geipel gave place to Mr. A. J. Lawson, who referred to the necessity of economising fuel in view of the prices now being fixed for electrical energy in Bills before Parliament, and touched upon the relative value of small bituminous and Welsh coal. He also at some length detailed the importance of

obtaining engines whose steam efficiencies have an inverse ratio to the cost of coal; if coal were 12s. per ton the engine used with the steam so raised should consume not more than 15 lbs. per I.H.P.-hour, if the price were 14s. then only 13 lbs. should be allowed, and so on.

Prof. R. H. Smith rather questioned the peculiar interest electrical, as distinct from other engineers, had in full economy. He put the case that there is less margin of profit in electrical engineering, and natural disabilities tell against it in competition. Thus electrical engineers are compelled to pay more attention to saving than other engineers. He again dwelt upon the number of boilers required to raise a given quantity of steam, cited the effect of feed heating, and condemned steam feed pumps as generally causing "a frightful waste of steam." He agreed with Mr. Crompton's use of a firebrick-lined furnace, and the reduction of amou of air admitted. Another speaker gave some general infor mation regarding the system of powdering coal, and burning it as fine dust. The three essentials he considered were a perfect mill, giving absolutely uniform powder, regularity in passing the dust into the combustion chamber, and the maintenance of a high temperature therein. There was no smoke, and but very slight slag, while fuels having fairly large percentages of incombustible matter could be so used. Major-General Webber wanted some particulars of the mill used to powder the coal.

Mr. Crompton replied on the whole discussion in Mr. Holliday's absence, and refused to be dragged off into side issues, such as relative advantages of different types of boiler. Mr. Ferranti had called attention to the lining of combustion chambers. Mr. Crompton had never seen it publicly stated what an enormous difference the character of the firebrick had upon the efficiency, and compared the conditions to those of incandescent gas mantles. He had found soft firebrick almost pipeclayey, not only not so easily melted, but most efficient. Long tests had the disadvantage over short tests, that the fires must be clinkered, but with his arrangement the fire was continuously clinkered. He regarded that Mr. Dugald Clerk was answered by Mr. Bertram Blount. Coming to Mr. Boot, he considered that the tests could not be fairly made with the same furnaces to get best results with each kind of coal, unless due care was taken to adjust draught, width of fire bars, &c., to suit each class. Slow oxidation was the cause of stored coal deteriorating. He had tried to force boilers by injecting oil fuel on the top of a coal fire, but, as might be expected, the supply of astatki ran out, and the experiment could not be continued. He considered Mr. Lawson's remarks thoroughly practical, but could not agree with Prof. Smith, as no one knew anything about cost of energy until electrical engineers published figures and located losses, and thought that "we have a monopoly" (a statement with which the meeting evidently thoroughly agreed). He wanted also to know if dust fuel or powdered coal was burned, where the incombustible went, either up the stack or in the flues, and flue cleaning might be a big item. With a remark that electrical engineers were purveyors of energy, the reply was closed, and the meeting adjourned, feeling that a very interesting and important subject has been fairly and somewhat fully dealt with.

THE ENCLOSED ELECTRIC MOTOR.

By SYDNEY F. WALKER.

The idea of the enclosed electric motor first arose from the reluctance of colliery owners to place electric motors, having in those days a visible spark at the commutator, in any position, such as near the working face of the coal, where an inflammable mixture of gas and air might be met with.

The writer pointed out repeatedly, in discussions on the subject at the different mining institutes, that the danger from this source was, at the utmost, very remote. Twenty years ago he had made careful and prolonged experiments with ordinary illuminating gas freely delivered at the surface of the commutator of a series wound Gramme dynamo, feeding arc lamps of the old Brockie commutating type, and, therefore, with plenty of sparking, but completely failed to produce ignition. It was also pointed out that there was far more danger from the spark which passes between the parted ends of a severed cable, but colliery owners would have none of it. Electric motors, they could see, would be of great service for pumping, especially from dip workings and for coal cutting, but if they were to be employed, the spark must be boxed in, so that the gaseous atmosphere could not reach it; and so the enclosed motor was gradually developed.

First, or nearly first, the writer believes, came Davis and Stokes's dynamo and motor, with the brushes carried in the cylindrical space inside the commutator, the outer end of the cylinder being closed by a glass disc. About the same time came various arrangements for enclosing the commutator only, with the brushes on the outside of the commutator cylinder for enclosing the field magnets separately, and finally for placing the whole of the motor in an iron box, a portion of which could be removed to regulate the brushes, make connections, &c. But none of these arrangements was really satisfactory, nor can it be said that the enclosed motor became a practical machine, until the problem was studied from first principles, and it was seen that the enclosing box itself could be made to form part of the magnetic circuit.

The enclosed motor designed on those lines is not only a very efficient apparatus in the sense in which efficiency is usually understood—viz., proportion of output to input—but it is also, when properly designed and properly constructed, a very efficient apparatus in the higher sense of the term, in the ability to keep on performing its work continuously, and of standing the strains that are brought upon it. It is also, other things being the same, and with proper machine tools for the purpose, a cheap machine to make.

Mines in which inflammable gas is present are not the only places where it is of advantage to have the working parts of both generators and motors protected from the surrounding atmosphere. In dip workings, in mines where no gas is present, and in which the great advantage of the electrically-driven pump consists in its ability to follow the water down as the workings recede, it occasionally happens that from a breakdown on the surface, from a strike or from other causes, the whole of the pumping plant, with its motor and gearing, is under water for a time, and it is then of great advantage to have the water kept away from the wire coils of the armature and field magnets. Again, in cotton and woollen mills, jute factories, rope works, foundries, and even in general engineering works, there are always a number of fine particles of the various materials dealt with in the works—cotton, wool, foundry sand, brass, iron and copper dust—floating in the atmosphere, and it is astonishing what a quantity of these particles find their way right into the interstices between the coils of the armature, into the spaces at the back of the commutator, on to the insulation of the brush holders, &c.

Now, these fine particles when first deposited and in small quantities are often undoubtedly quite harmless, so far as the dynamo or motor is concerned, but unfortunately they harbour moisture, oil of various kinds, copper and carbon dust, &c., and as the places in which they are deposited are always either directly in the path of the current, or in such positions as to form paths in parallel with some of the regular paths of the current within the dynamo or motor, shunts to some portion of the machine, the composition of the deposit is gradually altered by the passage of at first very minute currents through it, so that the insulation of the machine is broken down or so seriously reduced as to affect its efficiency, a very long time before this would happen if this deposit had not been present, and so the repairs bill is increased in consequence. Of course a good deal of this may be avoided by carefully blowing out these particles day by day; but usually it is not easy to get this done in a works devoted to the production of something quite different from electric currents, except in special cases, without extra expenditure on attendance.

And so the enclosed motor has naturally become a favourite. It can be fixed in all sorts of positions (all that is necessary being foundations, connection to the electric supply, and mechanical connection to the work) where one would hesitate to place an ordinary motor. One need not be so careful about keeping everything clear of the machine, so long as the terminals and pulley, or other mechanical connections, are protected.

But now as to the other side of the question. Doubts

have been expressed as to whether the enclosed motor is such a boon as those manufacturers who have devoted themselves specially to it would make out. In the first place, there is a complete absence of ventilation for the armature. The air within the motor is churned over and over again, its temperature rising to a very much higher point than it otherwise would do; instead of there being a change of air, an air current, however feeble, created by the revolution of the armature itself. This means, of course, that unless the heat can be got rid of in some other way, a lower current density must be the rule in armature and field magnet coils, or not only will the insulation be gradually broken down, but the proper regulation of the machine will be interfered with, since there will be an undue increase of the electrical resistances throughout the machine, and the output will also be reduced.

As against that, however, we have the fact that the enclosing box itself, which is in metallic connection at several points with both armature and field magnets, and which is also in close thermal conductive connection with the air contained in the chamber, is itself a very good radiator, presenting a large metallic surface to the surrounding atmosphere that can be arranged to radiate freely; so that it is doubtful whether the increase of temperature of the wire coils, in a properly designed enclosed motor, in which full advantage has been taken of all physical features, is a very serious matter. But whatever this may be, it merely means that an enclosed motor to perform certain work must be larger than an open one to do the same work, and the interest on the difference in the cost, if any, must be set off against the amount of the repairs bill saved, from the absence of the troubles mentioned above; and the user will also generally be prepared to pay rather more for the undoubted convenience.

Next there is always the undoubted fact, that in the enclosed motor the matter of the brush gear and its regulation presents more difficulty than with the unenclosed motor. The brushes cannot be got at so readily for regulation, and if such arrangements are made that they can be, there is a great danger that the motor will not only cease to be enclosed, but that it may be worse off than if it had remained simply unenclosed. But this means, again, that with enclosed motors the brush gear must be so arranged that regulation and attention of any kind are only required at such times that they can be done by a properly skilled attendant. And it may be taken that if motors of any kind are to be generally successful, this must be so. Users of enclosed motors, or someone about the works, may take sufficient interest in the machine to attend to and regulate the brushes where there is only one, or while the thing is new; but in these days everybody about works of any kind is usually far too busy to give any time to things of that nature. Engine and shafting go by themselves. If the electric motor requires frequent attention it will probably be put on one side, except in those cases where there are a sufficient number to pay for someone to be constantly going round them. Even in those cases proprietors and managers would far rather pay more, in reason, for a machine that did not require attention; and as every dynamo maker knows, the arrangement of the brush gear, so that it shall not require attention except at long intervals, is merely a matter of design and careful construction.

Next there is the matter of the oiling of the bearings. If this is not carefully arranged, the oil works down into the inside of the case, and is thrown upon various portions of the insulation. In the majority of cases, with the greater number of oils employed in lubrication, if it remained as oil, it would be comparatively harmless, but a layer of oil forms a bed for copper and carbon dust, such as may be delivered from the commutator, and for any dust that may happen to have got in when the machine has been opened, and the minute current which passes transforms the material, reduces the resistance of the insulating material it is laying on, say that between the brush holder and its rocker, and then we have the usual spark thrown across, with all its attendant troubles. But this, again, only means that the oiling arrangements must be properly designed, and that the design must be carefully carried out—that the oiling arrangements must be such that under no circumstances — accident, of course, excepted—shall the oil be able to find its way inside the motor chamber. Proper guard rings or other arrangements must be provided, such that the oil cannot work back along the spindle towards the armature, and in designing the arrangements for oiling, note must be taken of the whole of the conditions as to pressure, temperature, &c., inside and outside the motor chamber, and as to the effect of capillary attraction. It must also be arranged that if any overflow or any leak does take place from the oil reservoir under each bearing, the only path open for the oil shall be the outside of the case, where it can do no harm beyond wasting oil, and that there shall be no path open for it, under any circumstances, by which it can find its way inside the motor chamber.

Again, careful attention must be paid to temperatures and pressures that will rule within and without the motor chamber under ordinary working conditions and under extreme conditions. In fact, in the writer's opinion, the matter of temperatures and pressures within and without the motor chambers of enclosed motors, under all possible conditions, are worthy of a careful and exhaustive study, as well as the matter of the capillary spaces present in different parts of the chamber. Capillary attraction is always a troublesome matter to deal with. The writer has seen many an otherwise well designed apparatus, intended to work in damp places, wrecked entirely by capillary action. A space existed that the human eye could not see, that probably no known instrument could measure without the aid of a microscope, and through this space water has penetrated. To conclude, then, the enclosed motor, in the writer's opinion, has come to stay, provided it is designed on the lines he has indicated and is carefully made. Further, consumers, once they see the advantages of the enclosed over the open type motor, will be quite willing to pay more for it.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday resolved to lend £10,000 to the Whitechapel District Board for electric lighting purposes and £24,720 to the St. Pancras Vestry for works of a similar character.

Light Electric Railways.—The Finance Committee reminded the Council that in October they reported upon the financial bearings of proposals to construct light railways at Highgate, Clapham, New Cross, and Deptford, and that the Council then decided to apply for orders to authorise the construction of the railways. Since then the revised estimates of the cost had been prepared for the Highways Committee, the total in each case being as follows:—

Archway Road, Highgate	£8,399
Clapham, Wandsworth and Kingston Road	136,603
New Cross, Lewisham and Eltham	145,626
Deptford, Shooter's Hill and Woolwich	173,657

The figures given above do not include the cost of street widenings, a portion of which was to be charged to the light railways. The aggregate of the revised estimates was from £15,000 to £20,000 in excess of that of the earlier calculations on which the Committee's forecast of the probable financial results of the undertakings was based, and that excess would involve an extra charge of about £1,400 per annum to be met out of the traffic receipts.

Electric Lighting Loans.—The Finance Committee reported upon an application by the Bermondsey Vestry for a loan of £16,500 to defray the cost of freehold land as a site for an electricity station, and a refuse destructor and other purposes. The Committee recommended that the application should be granted, the loan to be advanced at the rate of 3½ per cent., repayable within 50 years.

Dr. Cooper, as an amendment, proposed that the recommendation should be referred back for further consideration. Colonel Ford having seconded the amendment, the Chairman of the Finance Committee expressed his willingness to take back the recommendation for the financial points to be placed before them by the mover of the amendment, and this the Council decided to agree to.

The Committee, in a further report, announced having had under consideration an application from the Newington Vestry for a loan of £15,500 for the extension of the plant at the generating station to meet the demand for current in excess of the original installation, and for an extension of the cables. The Vestry had asked that the loan might be repaid within 42 years, the repayment of the principal to be postponed and spread over the last 39 years. This method was adopted in the case of loans granted to the Vestry for the original installation, but as the money now required was for an extension of the initial expenditure, the Finance Committee thought that the commencement of repayment should not be postponed beyond the date when the repayment of the loan for the original installation commenced to operate, namely, two years from the present time. It was decided to sanction the loan on this basis, as recommended by the Committee.

Electric Traction.—Among the legislative proposals submitted by the Parliamentary Committee was the London County Tramways Bill. The Committee asked the Council to approve the Bill, to seal a petition for leave to bring in the measure in the ensuing session,

and to deposit the Bill according to the Standing Orders of Parliament. Colonel Ford, in reference to the Westminster Bridge—Tooting tramway, asked whether there ought not to be some limit of time within which the works should be carried out. The attitude of the Council in regard to Bills promoted by others was to endeavour to secure the insertion of a time limit, and he thought that the Council should be treated in the same manner. If the chairman of the Committee would not agree to that being done the speaker said that he would have to take steps for that being done through another channel.

Mr. E. A. Cornwall, chairman of the Parliamentary Committee, expressed surprise that the member had not read the Council's Bill. One of the clauses provided that if the tramways were not completed within five years the powers for constructing the lines or otherwise would cease on the expiration of that period. Perhaps the member before attempting opposition in another channel would make himself acquainted with all the clauses contained in the Bill.

Colonel Ford said that such steps would be taken, because the period fixed was as long as five years.

The recommendations were adopted. It was subsequently decided without discussion to approve the London County Tramways (No. 2) Bill, which proposes to authorise the Council to introduce electric traction on all or any of the tramways of the Council, and to remove the proviso which prohibits the use of electric traction on that part of the North Metropolitan tramway system which is situated in the county of London. It was also resolved to lodge the Bill together with a petition asking for leave to bring in the measure.

CORRESPONDENCE.

Tested Lamps.

Your correspondent, Mr. A. W. Gattie, does a considerable amount of fencing, but avoids the point at issue, *i.e.*, vague statements of tests by a firm who apparently exist for the purpose of accurate testing, and to account for the extraordinary behaviour of a lamp consuming considerably more current at the finish of its life than at the commencement.

If Mr. Gattie reads the Electrical Review of 1st inst., he will observe he is quite wrong. I replied to a paragraph in your journal, and he pays you unintentionally the deserved compliment that the Electrical Review can be the only highly technical journal.

Mr. Gattie's argument is a retort that I have made erroneous statements; this, too, is vague; disprove them, or point them out to me, and I will gladly explain. I do not mind in the least the threat of that distinguished engineer in the background "flooring" me. I rather welcome my remarks being taken up.

I am, indeed, pleased to hear that 95 per cent. of their trade is in English goods, and sincerely hope it will remain so, but that paragraph did not convey that idea in the least, the opposite, in fact.

Reply to "T. P. S."

I am afraid his experience with incandescent electric lamps is very limited.

Surely he does not imagine a filament is flashed in gas in the lamp bulb; he may rely upon it that the operations are quite separate, so how can the gas get left in the bulb? Moreover, if there was flashing gas left, or gas got put in, the whole thing would explode on coming in contact with a blowpipe. No, sir; incandescent lamps of my experience have vacuums, as near as possible, perfect.

I agree with him that efficient lamps are not necessarily English. I have tested foreign-made ones of about 16-c.p. at 2 watts per candle; but how about life?

He, too, has missed the point of contention. It is not what the Tested Lamp Company sell, but their inexplicit report.

One more point: 100-volt lamps are mostly flashed, 200-volt lamps are often not flashed. Where does the gas apply here?

English Electrical Engineer.

December 8th, 1899.

[In justice to the Electric "Tested Lamp" Company, we must remind our correspondent that the paragraph which he discusses was our own abstract, condensed from a fully illustrated article in our contemporary.—Eds. Elec. Rev.]

High and Low Speed Motors.

Your correspondent's reply in the Review of December 1st on the above subject evades the direct issue by importing conditions of his own making; I therefore beg a little more of your space, and will take his points *seriatim*.

1. I do *not* advocate "extremely" slow speed motors. Your correspondent's conversancy with continuous current work apparently does not extend to the knowledge that motors of 150 revolutions are in common use. Doubtless he will consider it incredible that not the least important of the four eminent makers to whom he refers supplies motors of 100 revolutions. Such, however, is the fact. Instances on this point could be multiplied; but repetition of facts that are common knowledge to the majority is unnecessary.

2. There was no "catch" in my offer.

3. The "ordinary two-pole machine" does *not* "represent present practice in this country" for slow speed motors for direct connection. The firms instanced by your correspondent would probably not thank him for inferring that they can only compete in the ordinary two-pole type. By his reference (in what he is pleased to term a "specification") to the supposed necessity for open motors (a condition not previously mentioned) I take it he further suggests that these firms do not make enclosed motors; this is not the case. They all make these, three of them, and probably the fourth also, in considerable numbers.

4. To deduce the "market price" of a slow speed motor from list prices of a type designed originally for high speeds is a proceeding which I think requires no comment.

5. Nothing whatever was said about retail prices in the original article, and I should be surprised to hear that the retail price of a 4-h.p. high speed motor from any of the firms mentioned was as low as £43, which I believe was the price stated; even if it were, the addition of the ordinary discount would not bring the *net* price, which I gave for the slow speed motor, up to £90 to £110, your correspondent's assumed "market price."

I am obliged for the suggestion as to business resulting; I may say, however, that like most other makers, my firm has as much work in hand as is convenient, and that as we already supply many readers of the Electrical Review, they do not require enlightenment on the subject. Further, my contributions to correspondence columns are not intended as advertisement.

In conclusion, I would suggest to your correspondent that it is not quite fair to invent new conditions to suit his own arguments; he resembles the gentle Boer, in that he does not abide by the rules of war. When the British soldier is unexpectedly fired on by an individual who has previously been wearing the white flag of a blameless life he cannot decline further contest because his adversary does not "play the game." But I can!

Lente.

Electricity Supply in London.

I think I have read strong remarks in the Electrical Review anent the pressure at which the City Electric Light Company at times supplies its consumers with *light* (?), but, at any rate, that company generally leaves you the hope-inspiring red hairpin as a promise of better times coming. To the unfortunate dwellers within the area supplied by the Metropolitan Electric Supply Company things are not so pleasant. There, for over a year, we have got so used to our red hairpin during the hours of maximum demand, that the company, evidently fearing lest we should become boastful, and look upon it as our right, have taken to cutting off the current altogether at these times. As witness last Thursday, light cut off from 6.45 to 8.15 p.m. Saturday, 4.15 to 9.45. Monday 4.30 to 9.45, and now comes enclosed notice which informs us that we are to have no more evening light till next Thursday, "by order of the secretary." Having had some experience of central station work, I can make every allowance for unavoidable failures, but not when they are caused by months of overloading their plant, and then getting over the "peak" difficulty by promptly cutting off the supply. I enclose my card.

Baker Street.

December 12th, 1899.

Signalling without Contact.

I have no desire to evade Mr. Boult's questions. My answers are :—

1. By landmarks, the presence of which can be felt even in a fog, such as bridges, cuttings, embankments, tunnels, points, catchpoints, stations, signal-boxes, sidings ; by the *feel* of the road ; by calculation and judgment.

2. A driver is supposed to know where a signal should be seen, but he is not expected to know whether it is at danger or at allright. The fogman with his hand-lamp and detonators repeats to the driver the position of the arm.

3. In the absence of a detonator, and in the absence of the fogman's green hand-signal at the point when it should be seen, the driver assumes that the signal is at danger.

4. I have not intentionally set up praise of the old method as a criticism of the new. What I have tried to point out is that the old system has not received fair play. It is not *dangerous, barbarous, and irregular ;* a driver does not blindly trust to the detonator. The old method is a good one, and gives excellent results. I have not said it is the best that can possibly be devised, but it will take a lot of beating.

5. A driver can read signals on the road, and at the same time keep a look out on his own road, on the opposite road, and look out for tail lamps and obstructions.

6. On every trunk line. I am sure Mr. Boult is sufficiently intimate with railways to know that there are many large station yards where the signal boxes are often not more than one-eighth of a mile apart.

I am sorry I have failed to drive home my points about the route indicators and single line signalling, but, after all, perhaps these are refinements which would be settled after the general principle of Mr. Boult's system had been accepted or otherwise.

In conclusion, I should like to add that if the present system is to be superseded, I am prepared to give it as my opinion that Mr. Boult has got hold of the right principle. However, I think the system he has built up will require considerable modification before it is generally acceptable, and if Mr. Boult should not be too closely attached to his system to see anything in it but perfection, I should be pleased to indicate to him the lines on which I think he might proceed, in order to give, not an ideal system of railway signalling, but a practical fog signal.

C. M. J.

[We have received a letter from Mr. J. W. Still on the subject of "Tested Lamps," which appears to have been roughly and inaccurately copied; we should be glad if Mr. Still would let us know his address, in order that we may obtain a correct version.—Eds. Elec. Rev]

THE ELECTRIC LIGHTING OF HEREFORD.

No small historical interest attaches to this ancient city on the Wye, which yesterday switched on its electricity supply with due formality. Quoting from an interesting account of the city and its lighting, prepared by Mr. J. Parker, the city engineer :—

Hereford was the capital of Mercia during the Heptarchy, and was fortified by Athelstan with walls and six gates. In 1055, Griffith, a Welsh king, defeated Ranulph, slew the bishop, seven canons, and the inhabitants indiscriminately, and burnt the Cathedral and city.

Stephen is said to have been crowned in the Cathedral, and during his reign the castle was constantly the scene of pillage, massacre and conflagrations. From its close proximity to the Principality it has always been exposed to the inroads of the Welsh, but within recent years these invasions have consisted of nothing more formidable than armies of ponies and droves of cattle, for which the extensive cattle market provides a convenient outlet to the other large centres of population.

The bishop's see was created in the time of Penda, King of Mercia, A.D. 680. Ethelbert was murdered here at the instigation of Offa, who, in expiation of his crimes, built the Cathedral, which was subsequently rebuilt by Bishop Athelstan in the eleventh century, but burnt by Griffith, a Welsh prince; the present Cathedral was commenced in A.D. 1107, and added to by other prelates from time to time.

The library contains some rare manuscripts, and a map of the world said to be the oldest in existence.

In Saxon times the bishops exercised civil jurisdiction, possessing many rights, taking tolls, &c. The first Charter of Incorporation dates from 1189, and was granted by Richard I. In 1382, the title of chief magistrate was changed from bailiff to that of mayor.

It is recorded that before the conquest of Wales, any alderman found riding without an attendant at a distance exceeding seven miles from the City was liable to a heavy fine, the chance of his capture by the Welsh, involving the risk of heavy ransom being demanded for his restoration.

In 1774 a special Act of Parliament was obtained for paving, cleansing, and lighting, the rate not to exceed 1s.

In 1816 another Act was passed for the above purposes and also for establishing markets.

The history of improvements in lighting repeats itself. Early in the century it appears that strong opposition was encountered to the introduction of gas; so at the close of the century the electric light could not be adopted without much opposition, considerable misrepresentation and some prejudice being overcome.

In 1820 a private company was formed for lighting the City with gas, at a cost not exceeding that of oil; the capital not to exceed £6,000. To this there was much opposition by the tallow chandlers of the City, one of whom declared at a town's meeting, "That if the City discontinued using Russian tallow, there would be no sailors for the Navy, and we should be invaded." So strong was the opposition that at a meeting of the Town Commissioners, held on December 18th, 1821, the following resolution was passed :—

"It is the unanimous opinion of this meeting that the City should not be lit with gas."

This unanimity evidently began to decline, for at a meeting held on December 24th, 1822, it was—

"Resolved to light the City with gas, provided it can be done at the same price as with oil."

The Act of Parliament was obtained in 1824, and Hereford lighted with gas in 1826. The City has not yet been invaded, as was predicted by the worthy tallow chandler.

The Town Council acquired the gas works in 1872, and erected new works soon after; further additions have been made, bringing the whole capital cost at the present time up to nearly £114,000. Doubtless the success obtained with gas has encouraged the Corporation to carry out the present undertaking.

The Corporation and City Magistrates having assembled in the Council Chamber at the Guildhall on Tuesday, the party formed a procession to the Electricity Works, where the Mayor having started the machinery and switched on the light, formally declared the works open in a short speech.

An adjournment was then made to the large room in the Market Hotel where luncheon was provided by the Mayor. The guests present numbered between 70 and 80, including Sir H. Croft, Sir James Rankin, M.P., Mr. Radcliffe Cooke, M.P., the members of the Corporation and the principal consumers.

The toasts included the following :—"The Mayor and Corporation and success to their new undertaking," proposed by Mr. Radcliffe Cooke, M.P. ; "The Engineers," proposed by Councillor Hewitt, and responded to by Mr. John Parker (City Engineer) and Mr. Stuart A. Russell (Chief Engineer of the Silvertown Company) ; "The Visitors," proposed by Sir James Rankin, M.P.

To commemorate the opening ceremony, a brass tablet was fixed on the wall of the engine room, stating that the works was opened on December 14th, 1899, by the Right Worshipful the Mayor, W. J. Humfrys, Esq., while the following names of the members of the Committee were appended :—

Aldermen H. C. Beddoe, T. Carver, T. Llanwarne, and J. R. Symonds; Councillors T. W. Clarke, J. Davies, and W. Hewitt; J. Carless, town clerk; J. Parker, A.M.I.C.E., city engineer; F. G. Poulton, electrical engineer.

In the evening of the same day the Mayor entertained the whole of the Corporation employés to dinner at the Drill Hall, the party numbering over 250.

Fatal Accident.—At the resumed inquest on the body of A. J. Barnes, who was killed recently at the Metropolitan Electric Supply Company's Works at Willesden, the jury found a verdict of accidental death, but added a rider to the effect that the machinery was not properly fenced in, and that there had been negligence on the part of the company in not protecting the machinery as provided for by the Act, and that greater supervision in the erection of machinery should be exercised by the Government.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Dec 13th, 1898		Week ending Dec. 12th, 1899.	
Adelaide	Value £44	Adelaide	Value £19
Auckland	115	„ Teleg. mat.	100
Bombay	10	Amsterdam	60
Boulogne	84	Auckland	53
Brisbane	12	Bangkok	126
Brussels. Teleg. mat.	200	Buenos Ayres. Teleg. mat.	1,278
Buenos Ayres. Teleg. mat.	512	Calais. Elec. batteries	60
Calcutta	62	Calcutta	31
Christiania. Teleg. mat.	494	Cape Town	259
Colombo	50	Chinde. Teleg. mat.	611
„ Teleg. mat.	1,397	Colombo. Teleg. wire	34
„ „ cable	34	Constantinople. Teleg. wire	35
Durban	25	Copenhagen. Teleg. mat.	180
Gothenburg	38	Durban	677
„ Teleg. cable	308	„ Teleg. mat.	3,202
Hamburg	265	East London	14
Launceston. Elec. meters	700	Fremantle	20
Liban	45	Hamburg	405
Madras	64	„ Teleg. mat.	290
Melbourne	533	Hong Kong	180
North Atlantic. Teleg. cable	4,500	Kobe	106
Ostend	51	„ Teleph. cable	396
Otago	62	Liban	35
Penang	58	Melbourne	38
Port Elizabeth. Elec. cable	158	Odessa	151
Reval	43	Perth	250
„ Teleg. mat.	312	Port Elizabeth. Teleg. wire and mat.	322
Rosario. Teleg. mat.	616	Port Said	20
Rotterdam. Teleg. mat.	388	Reval	210
Stockwell. Teleg. mat.	156	Rotterdam. Teleph. cable	109
Sydney	291	Shanghai	79
Yokohama	120	Singapore	17
Zanzibar	31	Stockholm. Teleg. wire	310
		Sydney	392
		Tokio	39
		„ Teleph. cable	691
		Townsville	45
		„ Teleg. wire	220
		Trinidad	46
		Wellington	67
		„ Teleph. mat.	1,294
Total	£11,781	Total	£12,352

Foreign Goods Transhipped.

Brisbane. Telep. apprts.	Value 909
Melbourne. Elec. motor	9
Yokohama. Teleph. apprts.	63
Total	£981

Bankruptcy Proceedings.—A receiving order has been made, on a creditor's petition, against W. Dalziell (W. Dalziell & Co.), electrical engineer, Newcastle-on-Tyne.

The first meeting of creditors and public examination in the failure of W. Rowbotham, electrical engineer, Teddington, are to be held on December 15th and January 9th respectively—the former at 24, Railway Approach, S.E., and the latter at the Court House, Kingston, Surrey.

In the failure of H. L. Howard (Thompson, Howard & Co.), electrical and mechanical engineer, York, similar proceedings will take place at York on December 19th and January 5th respectively.

Notice is given in the *London Gazette* of intended dividend in the case of W. A. Charles and J. S. Blackwell (Central Electrical and Engineering Company), Leicester and London. December 22nd is the last day for receiving proofs; trustee, W. M. Richards, 22, Belvoir Street, Leicester.

A sitting of the London Bankruptcy Court was held last week before Mr. Registrar Hope for the public examination of Edward Canning Glass, electrical engineer, lately carrying on business at 6 & 7, Nevill's Court, Fetter Lane, E.C., under the style of George Forrest & Son. The accounts show liabilities £1,098, and no available assets. In the course of his evidence the debtor stated that he purchased the business in 1896 for £2,000, and he had since spent a further £2,300 in extending it and putting down new plant. The business was still being carried on, but witness had no interest now in it. His sister had lent him from time to time sums amounting to £3,000, and in November, 1898, being unable to continue for want of further capital, he transferred the business to her in payment of the debt. Witness ascribed his failure to loss sustained in connection with the business, interest on borrowed moneys, and excess of personal expenditure over income. The examination was concluded.

Notice of intended dividend is given in the case of A. G. Inrig (Globe Electrical Company), electrical engineer, Victoria Park, London. December 27th is the last day for receiving proofs. Mr. E. H. Hawkins is the trustee, and his address is Offices of the Wholesale Traders' Association, 3, Barbican, E.C.

Liquidations, Dissolutions, &c.—At meetings held on October 30th and November 16th, the Bournemouth and District Electric Supply Company resolved to wind up voluntarily, and appointed Messrs. A. H. Sanderson and H. B. Renwick, liquidators, to carry into effect an agreement with the Bournemouth and Poole Electricity Supply Company, Limited.

Creditors of Vril Launches, Limited, should send particulars of debts, &c., to the liquidator (Mr. A. L. Dickinson, 19, Coleman Street, E.C.) by January 23rd, 1900.

A petition for winding up the Phaeton Electrical Company, Limited, (presented by A. Vandam and T. H. Marsh, trading as A. Vandam and Co.) is to be heard before Mr. Justice Wright on December 20th.

A meeting of the Northern Electric Wire and Cable Manufacturing Company will be held at Barum House, Harrison Road, Halifax, on January 17th to hear an account of the winding up from the liquidator, Mr. J. E. Whitham.

Westinghouse Direct Current Switchboards.—The offices of electric current are multitudinous, and its manipulation constantly assumes complex proportions, which make it extremely difficult to standardise the manufacture of switchboards, but this task has been grasped by the Westinghouse Electric and Manufacturing Company. Fig. 1 shows the front and fig. 2

Fig. 1.—Westinghouse Direct Current Switchboard.

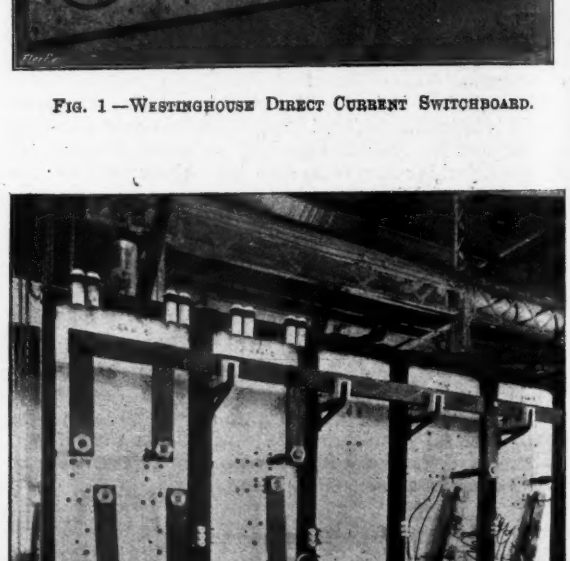


Fig. 2.—Westinghouse Direct Current Switchboard. Rear View.

the rear of a five-panelled Westinghouse switchboard for direct current lighting and power, erected at the works of the Park Gate Steel and Iron Company, Liverpool. The standard Westinghouse practice is well illustrated by this switchboard, which is for 250-volt service, but the type provides for the requirements usually arising for potentials not exceeding 750 volts.

The two panels to the left of fig. 1 control the two generators which are run in multiple, the middle panel is for the load, and the two to the right are feeder panels. The first generator panel is equipped with a single-light bracket, lamp and shade; an ammeter; a single-pole circuit breaker; a voltmeter plug receptacle; a triple-pole switch. The rheostat panel carries the resistance box, contacts and contact arms. The second generator panel provides for the operation of the other generator. The load panel carries an illuminated dial ammeter and an illuminated dial voltmeter, which swing on a hinge and can be readily seen by the operator when adjusting the generators for parallel running. The first feeder panel contains a single bracket, lamp and shade; a single-pole circuit breaker; and a double-pole switch. The second feeder panel contains two single-pole circuit breakers and two double-pole switches. As additions are made to a plant, extra panels for controlling generators and feeders can be added to the switchboard without interfering with the service. Flat conducting bars are used to connect the different instruments and the switches mounted upon each panel; each of these bars is of 300 amperes capacity. For very heavy currents a larger unit bar is used, a ventilating space being left between successive bars. The connections for the bus bars are arranged on each panel, and can be attached without difficulty. The Westinghouse standard adjustable jaw switches are used. The range of the ammeters exceeds the normal rating of the corresponding panels from 25 to 50 per cent. The switches, circuit breakers and all connections and terminals, carry the currents corresponding to their normal ratings continuously for an indefinite period, and without dangerous rise of temperature will carry temporary overloads not beyond the range of adjustment of the circuit breakers and the scales of the ammeters. The range of adjustment of the circuit breakers varies somewhat between the different sizes, but in general they may be set for any predetermined current between the limits of 75 per cent. and 150 per cent. of their normal ratings. Fuse panels with eight fuse holders are provided when required; they can be mounted in the space below the standard panels. These fuses are supplied for potentials not exceeding 250 volts, and for currents up to 600 amperes. For voltages exceeding 250, the fuses are not mounted upon the face of the board.

Bullock's. — The Bullock Electrical Manufacturing Company, of Cincinnati, whose motors and generators are well known, were compelled by increasing business to build new works in 1898, and these were occupied in January, 1899; but we are given to understand that the present prospects point to still further enlargement very soon. The company is now making electric street railway generators up to and including 800 KW. These generators possess new features among which may be mentioned a scheme for oscillating the brush holder mechanism in a direction parallel with the shaft. The movement is very slow and results in constantly changing the line of travel over the commutator face, and thus removes all tendency to cut or groove the latter. The action is the same as secured by the end play of an armature in a belted generator or that produced by the electro-magnetic device used at the end of shaft on rotary transformers, and which is recognised by engineers as a means of greatly prolonging the life of the commutator. The pole pieces and coils may be removed without disturbing the yoke or armature, and with two of them removed, it is possible to remove one or more armature coils should repairs be necessary. The armature coils are made of continuous bars of copper without joints between the commutator connections, which materially adds to the life of the machine. These coils are all thoroughly insulated, pressed and baked, before being placed on the core, no additional core insulation being necessary. All armatures are thoroughly ventilated by slots perpendicular to the shaft through which the air rushes when the machine is in operation. A liberal rating permits of constant operation at full load with low temperature rise. An 800 KW. machine recently supplied to the Oakland Rapid Transit Company, of Oakland, Cal., is shown in fig. 1. This machine operates at a speed of 80 revolutions per minute, and at this speed develops 550 volts at no load. It is over-compounded for a rise of 50 volts at full load making the full load voltage 600. In fig. 2 we show a 28-inch swing screw cutting engine lathe driven by "Bullock" type "N" motor. As will be seen, the motor is placed directly on the spindle in the head stock, taking the place of the cone pulleys. The armature spider is built directly upon the hollow spindle of the lathe. By means of a new system of variable speed control, the motor is given a greater range of speed, without loss of torque, than is ordinarily given by the cone pulley, having 16 speeds in either direction including the back gear. The controller is placed upon the leg of the lathe directly under the head stock, and is operated by a splined shaft running along the bed of the lathe, and a handle which travels with the carriage. The slowest speed is 60 and the highest about 250 revolutions.

Brockie-Pell Arc Lamp, Limited.—We are informed that in consequence of the great demand for their patent Brockie-Pell arc lamps this company will shortly be removing from Tabernacle Street to larger and more suitable premises in Worship Street, Finsbury, E.C. Amongst the orders on hand are arc lamps for the street lighting of St. Pancras, Shoreditch, Poplar, Gloucester, Stirling and South Shields. The arc lamps employed in connection with the Greenock electricity undertaking just completed were also supplied by this company.

Catalogues and Lists.—The British Westinghouse Electric and Manufacturing Company, Limited, of Westinghouse Building, Norfolk Street, Strand, W.C., send us copies of their "November, 1899," lists as follows:—No. 1,000, polyphase induction motors; 1,001, belt-driven railway generators; 1,002, generators and rotary converters for electrolytic work; 1,003, direct current engine type generators for lighting (125 volts); 1,004, direct current ditto for motor driving, &c. (250 volts). All of the lists are excellently illustrated.

In a new catalogue just issued by the United Asbestos Company, Limited, the whole of the various branches of the company are, for the first time, brought together into one volume. These embrace asbestos goods, rubber manufactures of every description for mechanical purposes; lubricants; boiler and pipe coverings in various forms; and engineers' sundries. Among the latter will be found many useful specialities as well as all those ordinary stores, tools, and requisites which are an everyday necessity to the steam user. Packing and jointing materials are exhaustively treated. These cover not only the asbestos in all its forms, but rubber, gutta-percha, fibre, canvas, hemp, metallic packings, &c., facilitating selection of whatever special packing or jointing materials are best adapted to the particular requirements of the customer. This company has held Admiralty contracts for 14 years in succession.

The Universal Electric Supply Company, of Manchester, have sent out a new edition of their illustrated price list of electric bells, alarms, medical coils, cycle lamps, and sundry electrical fittings and accessories for lighting and other work.

Messrs. A. J. Beaumont & Co., of York, send a small pamphlet of their projectors and arc lamps for theatre, stage, cinematograph and other scientific purposes.

Exhibition in Crete.—It has been arranged to hold an international industrial and commercial exhibition at Canea in April, 1900, under the patronage of Prince George of Greece. The object of the exhibition is to promote both import and export trade. Mr. Arthur Gobiet, Prague-Karolinenthal (Böhmen), has been appointed manager of the exhibition. A committee, which consists of members of the consular body and other distinguished representatives of Cretan trade, is presided over by Mr. D. Constantin M. Foumis, Chancellor of Finances to Prince George.

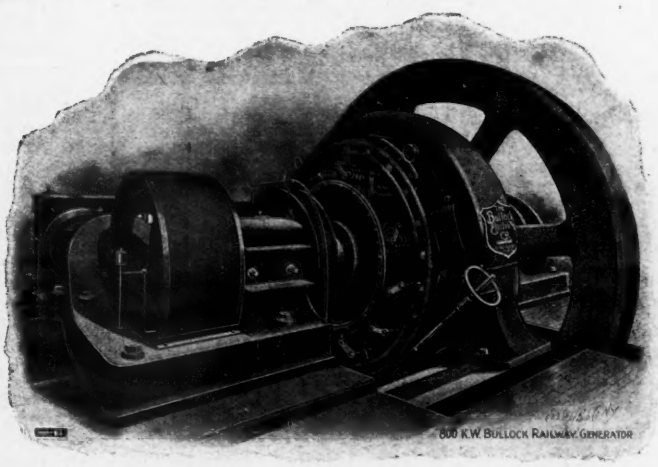


Fig 1.—Bullock Generator

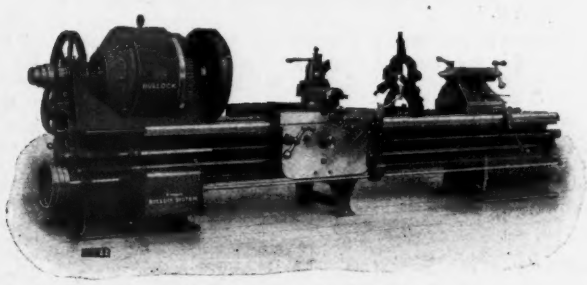


Fig. 2.—Bullock Motor on Lathe.

Foreign Competition.—The ninth annual dinner of the officials and foremen employed by Messrs. John Fowler & Co., Limited, at Hunslet, was held on Saturday at the Great Northern Railway Station Hotel, Leeds. Mr. W. Fowler, in responding to a toast, alluded to the competition of the United States and Germany. He was told that they were going to have a lot more competition from Germany, but he was not very much afraid of it. If they still did the work well and kept up their character, they would not be beaten either by the Germans or the Americans If the employed and the employers were united in the common interest, they would have no need to fear. Only they must get their work out quickly and well.

The Americans were proud of the fact that they paid the highest wages with the lowest total cost of production of any country in the world. They ought to aim at that themselves. The Americans were also proud because they had sent some locomotives over here, but he did not hear a very good account of them. The secret of the expedition with which the Americans turned out work was the vigorous use they made of labour-saving machinery. The more talent and skill we showed in this matter the better it would be for everybody concerned. In response to another toast, Mr. Eddison said that they might depend upon it that the battle for engineering supremacy was about to begin, and we should have to fight our way along with other countries. The system of standardising the products of machinery was coming very much to the front, and it was a matter they ought to pay attention to, together with the organisation of shops.—Mr. R. H. Fowler also responded. Last year they made a new type of engine for electric lighting, and they had just supplied a large engine to the Leeds Corporation. It was running very satisfactorily.

Hereford.—Messrs. Read & Jenkins, of Hereford, who have been busy during the last three months on installation work here, have secured contracts under the Corporation for the lighting of the new electricity works and the Markets, also the wiring of the Shire Hall for the Herefordshire County Council. They are putting in a complete installation at the Green Dragon Hotel and are also fitting up several business premises, shops and private residences, &c.

Salmony v. Pitard.—In the Westminster County Court on Thursday last week, Messrs. Salmony, electrical engineers, sued Mr. Pitard for the cost of some electrical fitting. Defendant said the fitting was delivered to him for the purpose of making others like it for the plaintiffs. It was necessary to take it to pieces and send those pieces to different firms for making. This was done, and with the exception of the parts they themselves made, they had not any other portion of the fitting. The estimate was too high so that they never obtained an order. There was no contract to pay, and it was not usual to pay for things sent in this way.—His Honour said there was no contract to pay, and plaintiffs' clerk was not able to do more than produce a book showing the delivery, and Mr. Pitard said no account was sent him until nearly two years after.—Judgment was given for the defendant.

Smoke Persecution.—At the Bow Street Police Court on 7th inst. the Metropolitan Electric Supply Company, Limited, were summoned before Mr. De Rutzen for allowing the chimney at their electric lighting station in Sardinia Street, Lincoln's Inn Fields, to send forth black smoke in such a quantity as to be a nuisance on the 23rd and 24th ult. Mr. Muir said the defendants had taken every precaution to prevent nuisance. They had entered into a contract with a well-known firm to supply them with smokeless coal under any circumstances; but owing to the enormous demand for coal of this class in consequence of the war in South Africa, an inferior article had been sent in. The defendant company strongly protested, and after buying coal of the proper quality from other persons were supplied with coal of the specified quality from their own contractors. He knew that a penalty must be imposed, but the defendants had done all in their power to comply with the Act, and he thought that the circumstance he had mentioned was of a mitigating character.—Mr. De Rutzen: The public have a grievance against you. You have apparently a grievance against the coal contractors. I have nothing to do with that. I must order the defendants to abate the nuisance and pay £2 2s. costs.

Theatre Lighting.—Messrs. Sax, Slatter & Co. have carried out the electric light installation and fittings at the newly-erected Holloway Empire Theatre of Varieties.

Trade Announcements.—Messrs. Wilhelm & Co. have removed from 11 and 12 to 3, Westmorland Buildings, Aldersgate Street, E.C.

Messrs. Estler Bros. have removed from 27, Leadenhall Street, E.C., to larger and more convenient premises at 25, Laurence Pountney Lane, E.C.

Woodhouse & Rawson United.—But for the following, which appeared in the *Financial Times* of 7th inst., we should have continued under the impression that the last had been heard of Woodhouse & Rawson United:—

> Sir,—Can anybody tell me anything about the estate of Woodhouse & Rawson, Limited, or give me the name of someone who can? I am sorry to trouble you, but I have heard nothing of the matter since June 95th, 1897, when I had a notice from the Official Receiver to say that he had £104,000 in hand, and that he was going to apply for his release, and that if I had any objection to his release, I must notify it to the Board of Trade. I suppose he got his release in due course, but he might have told us what he did with our money.—I am, &c.,
> A Debenture Holder.
>
> *December 5th*, 1899.

Workmen's Compensation.—At Paisley a decision has been given by Sheriff Henderson in an action taken by a joiner, residing in Stockton-on-Tees, against Messrs. Paterson, Cooper & Co., electrical engineers, Paisley. Pursuer was employed in erecting the woodwork in connection with a contract which they held for putting in an installation of electric light into an unfinished ship which had been launched from the yard of Sir Raylton Dixon & Co., Limited, at Middlesborough. He fell down an opening in the ship's deck and fractured his pelvis, and the action was raised under the Workmen's Compensation Act. Defenders urged that the employment at which pursuer was engaged at the time of the accident, not being an employment to which this Act applies, they should be assoilzied with costs. His Lordship held that pursuer was at the time when he was injured employed in working in a factory in the sense of the Act. He accordingly found defenders liable to pursuer in compensation for his injuries, but in the respect that their extent and the probable duration of pursuer's incapacity to work have not yet been ascertained, continued the cause on the roll until such time as the same should be reported on.

ELECTRIC LIGHTING NOTES.

Alfreton.—A committee of the District Council has been gathering information on the subject of electric lighting, and has instructed an engineer to report on the matter.

Ballycastle.—The District Council have the question of electric lighting under consideration.

Bangor.—The City Council has decided to confirm an agreement with the National Electric Wiring Company, dealing with the free wiring of premises for electric light.

Bath.—The half-yearly report shows an increase of £111 in the income for the six months ending September 30th last, as compared with last year, and a deficit on the whole of about £1,300.

Beverley.—The Town Council intends to obtain expert advice as to the adoption of electric lighting within the borough.

Bolton.—Some inconvenience has been felt at Bolton lately through a temporary failure of the electric light. At the last meeting of the Borough Council the chairman of the Electricity Committee stated that the mains had been overloaded in some districts to the extent of 50 per cent. He asked for the consideration of consumers on that account, adding that the additional plant now being laid down would *relieve the pressure* early in the new year.

Bradford.—The Council has adopted the recommendation of the Electricity Committee to accept Mr. Gibbings's resignation from March 31st next, and will advertise for a successor at £500 per annum. The recommendation retaining Mr. Gibbings as consulting engineer is, it appears, to be further considered by the Committee. It is proposed to retain him until a qualified successor is appointed.

Brecon.—The Town Council on Tuesday affixed its seal to a memorial to the Board of Trade for a provisional order.

Cardiff.—At a meeting of the Town Council on Monday it was stated, with reference to the action brought by the Corporation against Messrs. Ferranti, that the sub-committee was prepared to settle the action on the payment of £2,500 and costs. The action was now ripe for trial, and £1,500 had been paid into Court by the defendants.

Cheltenham.—The Town Council is about to obtain the sanction of the Local Government Board to a loan of £17,500 for electric lighting extension purposes.

Chichester.—Mr. Price, of Portsmouth Electricity Works, has submitted a report to the Chichester Town Council on a scheme for the establishment of a refuse destructor, electricity works, and waterworks pumping plant near the city, which has been prepared by Mr. J. Saunders, the city surveyor. The estimated expenditure on the electric lighting department is £22,000, and Mr. Price anticipates an immediate annual profit of £167, while he strongly recommends the adoption of the scheme as an admirable one.

Deal.—The District Council has under consideration the question of supplying electricity for lighting and traction in the district.

Dumfries.—The Provost's Committee of the Town Council has decided to make inquiries from other burghs concerning the cost and working results of electric lighting.

Durham.—The City Council has approved of the sealing of an agreement between the Corporation and the representatives of the County of Durham Electric Power Distribution Company for the transferring of the electric order to that company.

Eastbourne.—A Local Government Board inquiry was held on the 7th inst. by Col. A. J. Hepper, D.S.O., R.E., with respect to an application by the Corporation to borrow the sum of £88,635 for the purchase of the electric lighting installation of the borough. The town clerk, in stating the case for the Corporation, said a resolution was passed by the Council on August 2nd, 1899, to apply for sanction to borrow the sum of £82,135 for purchasing the undertaking. Of this sum £80,135 was for the purchase, £2,000 compensation to officers, and £6,500 had been added for new plant and machinery. The subject had been before the Council since 1897, when they instructed Mr. Hawtayne to ascertain the cost of providing electric light for public purposes in the borough. Whereas the Corporation lighting bill was then £5,923 per annum, Mr. Hawtayne advised them that to put down their own plant for light equal to that then received would cost £3,671 per annum, which would result in a considerable saving per annum on the lighting of public buildings and lamps. A provisional order, both for public and private purposes, was obtained, and negotiations were entered into with the company for the purchase of their undertaking. At first there was considerable difference between the company and Corporation, but the former ultimately agreed to come to terms. The company's profits for 1898 amounted to £4,574 5s. 6d., and they had based their calculations on an 18-years' purchase. The gross profits of the company in 1896 were £3,141, in 1897, £3,619, and in 1898, £4,574, and for three-quarters of the present year the profits had been £1,164 more than for the corre-

sponding period of 1898.—Mr. Allcock subsequently pointed out that the estimated increase in the profits for 1899 over 1898 would be between £1,700 and £1,800.—Proceeding, the town clerk said that notwithstanding the high charge of the company, namely, 7½d. per unit, which they thought could and ought to be reduced to 5d. or 6d., even if this reduction took place, there was every reason to believe that the increase in the profits would not only be maintained, but be still further augmented. There was a small amount of opposition to the proposal.

Dundee.—The electricity rental from May 15th to the present date amounted to £2,824 13s. 5d., showing an increase compared with the same period last year of £697 0s. 4d. During November the number of new consumers had been 30, the number of new lamps connected 1,773, the units generated 115,000, the coal used 372 tons, or 7·24 lbs. per unit generated. Exhaust pipes were ordered to be procured from Messrs. Cooper & Greig at 14s. 4d. per cwt.

Edinburgh.—The Electric Lighting Committee recommends the resident electrical engineer for an advance of £150 a year.

Electric Lighting in the Far East.—The East Chinese Railway authorities in St. Petersburg have just placed a contract with Messrs. Ganz & Co., of Buda-Pesth, for the establishment and equipment of a large central power station at Port Arthur to supply the electrical energy for the lighting of the port and for the operation of the dock cranes, &c.

Epsom.—The District Council has received a communication from Messrs. Baker, Lees & Co., giving notice that the Cobham Gas Company intends to apply to the Board of Trade for a provisional order to authorise the company to supply electricity within the whole of the parishes of Cobham, Stoke d'Abernon, and so much of the parish of Byfleet as lies to the east of the river Wey navigation canal. The matter was adjourned for a fortnight to enable the Cobham Parish Council to consider the proposal.

The Local Government Board has written to the District Council sanctioning a loan for £16,100 for the purpose of carrying out the electric lighting of the town, the money to be repaid in 25 years.

Festiniog.—The District Council has decided to drop the proposition to apply for powers for electric lighting, and will negotiate with a company which is already supplying portions of the district.

Garston.—The opposition to the transfer of the Council's electric lighting order to the Garston Electric Lighting Company has been withdrawn. It is stated that a company, "practically the same as the lighting company," has in hand a scheme for electric tramways, and the Council seems inclined to favour the keeping of the two concerns under one control. It is proposed to construct an electrical line from Otterspool to Garston, thus connecting with the Liverpool tramways.

Gateshead.—The Town Council has received notice from the County of Durham Electric Power Supply Company of its intention to apply to Parliament for powers to supply electricity in bulk to lighting authorities and others within the Poor Law Union of Gateshead. The Tyneside Electric Power Company is also in negotiation with the Council.

Germany.—A large central station is approaching completion in the town of Essen. The plant, which is being installed by Messrs. Lahmeyer & Co., of Frankfort, will have a capacity of 4,500 H.P.

Glossop.—The Corporation notifies in the *London Gazette* its intention to transfer the 1899 provisional order to the Urban Electric Supply Company on specified conditions.

Grantham.—The Town Council have adopted the recommendation of a committee to the effect that consent be given to the application of the Urban Electric Supply Company, Limited, for powers to supply electricity in the district.

Heysham.—The Lighting Committee of the District Council is negotiating with the Morecambe Electric Lighting Committee for the supply of electricity in Heysham.

Howth and Sutton.—On Thursday last week, Dr. Edgar Flinn, Local Government Board inspector, held an inquiry into the application of the North Dublin District Council for powers to supply electricity in the districts of Howth and Sutton. The ratable value of the districts is £10,058, permanent population 2,500, rising to 5,000 in the summer. Evidence was had both for and against, several ratepayers, including the Earl of Howth, favouring the use of *oil lamps!*

Inverness.—The Town Council has resolved to introduce the electric light on the low tension system, as the radius to be covered will not extend over two miles.

Leek.—The District Council have received a report on an electric lighting scheme from Messrs. Burstall & Monkhouse. The cost of the plant is estimated at £9,300, exclusive of buildings, and the total cost at £13,000.

Limerick.—The Board of Trade have postponed the consideration of the question of revoking the Corporation's provisional order for six months.

Leith.—The Treasurer's Committee's report to the Town Council shows that the capital expenditure for electric lighting purposes to date amounts to £35,634, and that in view of the extensions which are constantly required it will be necessary to borrow a further sum of £10,000.

London.—In reply to several letters which have recently appeared in the *Times* on the subject of interruptions in the supply of electricity in certain portions of districts of the Metropolitan Electric Supply Company, Mr. E. Cunliffe Owen, secretary of the company, has written to that journal, making the following explanation:—

> More than two years ago the company, finding it impossible to enlarge their existing stations in London, commenced the erection of large generating works at Willesden. These works have been equipped with machinery of unusual magnitude and of the most modern construction, but owing to delays in the delivery of ironwork, they have only recently commenced to run. When it was found that this delay might prejudicially affect a portion of the general supply, arrangements were made for obtaining help from a neighbouring undertaking, but this assistance failed when most required. The machinery at Willesden promises to give every satisfaction both mechanically and electrically, but as only one of the three 2,500-H.P. engines is as yet in working order, it has not been considered prudent to work this machine to its full power. It is, however, confidently anticipated that the second machine will be available in the course of a few days, and the third machine very shortly. With the help obtained by the partial working of Willesden, the company would have been able to meet all their demands with satisfaction had it not been for the sudden stoppage of supplies of the best quality of Welsh coal owing, it is understood, to the requirements of the Government for the South African transports. Every effort has been made to obtain deliveries regardless of cost, but practically without success, and the coal at present being received renders it almost impossible to maintain a proper pressure of steam at times of greatest demand. I am, in conclusion, to state that every effort is being made, and no expense is being spared, to restore an adequate supply, and it is confidently believed that this will be possible in the course of the next few days.

Among other letters on the subject appearing in the *Times* is one from "Zetetes," who ends thus:—"In conclusion, I should like to ask the secretary to state whether there is any, and if so, what, foundation for the rumour that the new cable connecting the local with the Willesden works has been found to be defective and to require replacing, so that even if the machinery at Willesden were all in order, the supply could not be efficiently transmitted to London for months yet."

To this the company's secretary replies as follows:—"In reply to the question asked as to the condition of the mains which connect our works at Willesden with our London works, I am instructed to say that since the time that the Willesden works commenced supplying current there has been no trouble of any description with the mains. These mains are of ample capacity to transmit all the current which will be generated at these works on the completion of the present plant."

To this "Zetetes" again replies. He says that the secretary should have added a postscript "as to why the mains 'of ample capacity' were not used to supply us from the Willesden works which have 'commenced supplying current' during the execution of these repairs. It will be noted that the secretary does not say that there has not been any trouble with the cable, though he might easily have added that its insulation is perfect, and that there is no present expectation that any part of it will have to be replaced." He advocates united action on the part of consumers.

The Paddington Vestry is threatening the Metropolitan Electric Supply Company with legal proceedings on account of the alleged frequent failures of the electricity supply in the parish. This district is now, we believe, being supplied from the new works at Willesden. No doubt things will run more smoothly when time has been allowed for them to settle down.

It is stated in the daily press that on the morning (?) of the same day, the Foreign Office, Colonial Office, and other Government buildings in Whitehall suffered inconvenience from a failure in the supply of electric current. A short circuit on the main was located shortly after.

Loughton.—On the recommendation of the Gas and Electricity Committee the Town Council agreed to instruct the gas manager to prepare the necessary plans and specifications in connection with electricity supply in the borough.

Much Woolton.—The District Council has had under consideration the application of the Liverpool District Electric Lighting Company for power to transfer its order with respect to Much and Little Woolton and Allerton to a new company called the Garston District Electric Supply Company. It was stated that the probable result of the transfer would be that the charge for electricity would be reduced, because the new company would supply a much larger area. Although the Council did not pass any resolution, it was understood that no opposition would be offered.

Plymouth.—The demand for electrical supply has increased so rapidly, that although the works was only opened in September last, it has already been found necessary to prepare a scheme for extensions of the plant and buildings to about double their present capacity.

Poplar.—The Board of Works has approved of an expenditure of £4,370 on the buildings of the electricity works in addition to the sum already sanctioned.

Rawtenstall.—The Corporation has now under consideration the advisability of erecting electricity works in the borough with the view to the town being lighted by electricity. The conversion of the local steam tramways to electric traction is also being discussed.

Redcar.—The District Council has adopted the recommendation of the Electric Lighting Committee to the effect that the District Council should borrow £10,000 for electric supply purposes.

Sale.—The District Council is discontented with the slow progress of the negotiations with the Manchester Corporation with regard to the supply of electricity, and intends to consult the Stretford Council on the subject.

Seaham Harbour.—The District Council has received a letter from the County of Durham Electrical Power Distributing Company, stating that it was the intention of this company to seek powers to supply electricity in the Council's district.

Spain.—A company has just been formed at Bilbao, with a capital of £200,000 and with the title La Sociedad General de Centrales Electricas, to acquire and carry on as joint concerns the central stations in the towns of Torrevieja Real Sitio de San Lorenzo, Escorial de Abajo, Nava del Rey, Medina de Rioseco, Lorca, Almaden Marchena, Arahal, Paradas, Cebreros, El Tiemblo, San Martin de Valdeiglesias, and Santander.

Stirling.—The Police Commission has appointed Mr. A. C. Hanson (27), Smithfield Markets Electric Supply Company, London, resident electrical engineer, at £200 per annum.

Tiverton.—The Town Council, having considered a report on the electric lighting question prepared by the borough engineer, Mr. J. Siddalls, has resolved to carry its provisional order into effect at an estimated initial outlay of £6,000.

Tonbridge.—The Electric Lighting Committee has decided to confer with Mr. Hammond with a view to his acting as consulting engineer in connection with the proposed electricity works.

Torquay.—The Corporation has received the sanction of the Local Government Board for a loan of £7,145 out of £10,000 applied for, £200 being deducted in respect of rectifiers and the balance in respect of the central station. The Board is to be asked to sanction the balance, a statement showing the particulars of the excess expenditure over £22,300, the amount of the original loan for the installation of the electric light having been supplied by the consulting electrical engineer.

The electricity works are now almost fully loaded; the engineer has been instructed to prepare a report on the necessary extensions.

Tunbridge Wells.—On Friday last Colonel Hepper held an inquiry on behalf of the Local Government Board in regard to the proposed new loans for electric light extension purposes. The town clerk explained that the present population of the borough was 32,000, and it was proposed to extend the borough boundary by the inclusion of districts on the east and west. The total amount of the loan at present required was £25,000, and it was likely that as the borough developed another loan would be wanted. The present outstanding loan for the borough stood at £368,840, and the electric lighting loans so far borrowed had been £40,000. The present application was purely for extension purposes, the lamps at present numbering 24,000. The electrical engineer, Mr. Boot, explained the machinery needed, and the arrangements made, the cost of which would be covered by the loan of £25,000, and there being no opposition, the inquiry closed.

Tynemouth.—The Town Council on Tuesday passed a resolution to borrow from the Public Works Loan Board the sum of £34,850 for the electricity works and the purchase of land.

Walsall.—At a meeting of the Town Council on Monday the town clerk was instructed to make application to the Local Government Board for their sanction to the Council borrowing £15,000 for the purposes of the electric lighting undertaking, and to defray the cost of providing and erecting an additional engine and boiler, with the necessary transformers, condensing and other plant, at the Wolverhampton Street generating station, in order to enable the Electric Lighting Committee to meet the increased demand for current, which by the winter of 1900 will exceed the capacity of the present works.

Mr. Brownhill, chairman of the committee, explained that the demand for electricity had in one year increased by 50 per cent., with the result that the plant was now working at its fullest capacity.

Warrington.—The electric light is being introduced into the union workhouse at Warrington. The Guardians have accepted the tender of Messrs. Killick & Cochran, of Liverpool, to supply certain machinery, &c., at a cost of £510.

West Bromwich.—The Council have approved a contract which the Electric Lighting Committee have entered into for the purchase of five acres of land for £1,250 for the site of the generating station.

Whitechapel.—The *Contract Journal* says that four or five weeks ago the Whitechapel District Board invited tenders for the construction of a portion of the electrical supply station at Osburn Street. Fourteen different firms tendered, and the tender of Messrs. Griffiths at £4,950 was accepted. Messrs. Mather & Platt were also invited to contract with the Board for the supply of three new engines and dynamos of 275 KW. capacity at the price already agreed to be paid (£2,465 per engine and dynamo) by the Board under their present contract with that firm, but that no spare armature be ordered, and, if assented to by the company, that the necessary contract be prepared—total cost, £7,395. It was also decided that a contract be entered into between the Board and Messrs. Babcock & Wilcox, Limited, for the supply of two new boilers, each capable of evaporating 11,000 lbs. of water per hour, at 180 lbs. steam pressure per square inch, and one feed pump capable of discharging 10,000 gallons per hour at the above-mentioned pressure; in the event of Messrs. Babcock & Wilcox, Limited, being willing to enter into an agreement for such supply upon the same conditions as they are supplying boilers and feed pumps to the Board under the contracts which they entered into with this Board in April last; estimated cost, £2,660.

Wigan.—The Council has empowered the engineer to proceed with the arrangements for lighting the baths electrically. He is also to prepare estimates for wiring the municipal buildings.

Yeadon.—The District Council has received notice from the Board of Trade that as the Council has engaged an expert to advise it on the carrying out of the electric lighting order obtained in 1894, it would defer the consideration of the revoking of the order for a period of 12 months.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool and Fleetwood.—At Liverpool last week a farmer named Swift recovered £700 damages for personal injuries caused by a car of the Blackpool and Fleetwood Tramroad Company. Plaintiff's milk cart was standing by the roadside when defendant's car frightened his horse. In the result plaintiff was thrown from the cart and the car wheels went over his left arm so that it had to be amputated. Plaintiff had previously lost his other arm in a shooting accident, hence the enhanced value of the one of which the tramway company deprived him.

Bury (Lancs.).—At their last meeting the Bury Tramways Committee discussed at length the position of the borough in relation to tramways, and agreed upon the desirability of appointing a consulting electrical engineer.

Cinque Ports.—The Dover Town Council had the Cinque Ports electric tramway scheme before it last week. The town clerk reported that the suggestions so far as the scheme concerned Dover were that the line should be brought down Castle Hill, Castle Street, and into the Market Square, where it would join the Dover electric tramways, and thence run over the Maxton line and on to Folkestone. The town clerk added that it was an important matter so far as the Council was concerned that anyone should be granted power to lay rails through the streets and obtain running powers over the local tramways, thus upsetting the service. He would suggest that the surveyor and himself should be instructed to consult Mr. S. Sellon, the Council's electrical expert, previous to making a report on the matter. This course was adopted by the Council.

Darlington.—The Imperial Tramways Company desires to drop for the present about 4½ miles of line which formed part of its original Darlington electric tramway scheme. The Town Council, however, does not seem to fall in with the proposal, and it last week notified the company that it does not intend to in any way depart from the original proposals. The Tramways Committee met on Monday to consider the matter, and received a deputation from the company, including Mr. J. Clifton Robinson, Mr. Holmes, the local engineer, and the solicitor. The Committee came to no decision, but will call a meeting of the General Purposes Committee. The company proposed laying cables from the Stockton generating station for supplying the Darlington lines, but the local authorities want extortionate wayleaves. The Light Railway Commissioners recommended the promoters to take supply from the Darlington electricity works when completed. It is now hinted in a Darlington paper that if the Council insist upon the whole of the lines being laid down now, the company may either drop the whole scheme or apply to the Board of Trade for authority to erect a power station of their own in the town.

Dover.—It is stated that in response to petitions from the working people, cars are to be run at special hours on the municipal electric tramways at a fare of a ½d. over the three miles of track. The ordinary fare is a 1d. for the same distance, and this has realised a profit of £2,000 a year.

Dublin.—In the Southern Police Court on Saturday last week, Mr. Swifte gave judgment in the case brought by the Corporation against the Dublin United Tramway Company for not sanding the portions of the streets run over by the electric trams. Mr. Swifte convicted on both summonses, and fined the defendants £5 and £10 costs in each case.

A span wire broke in College Green on 7th inst. It was soon removed, but not before a young man who was passing received a shock.

Gomersal.—The District Council has passed a resolution assenting to the tramway scheme of the British Electric Traction Company, but assent to the Liversedge Council's electric lighting scheme has been withheld so far as regards the lighting of any portion of the Gomersal district.

Holderness.—The Hornsea Urban Council has received a letter from the Manchester Industrials Company, Limited, stating that the proposed light railway for the district will be constructed on the electric trolley system. Further details were given showing the company's proposals regarding goods and passenger traffic.

Litherland.—The Liverpool Tramway Committee have written to the District Council to the effect that they consider it desirable that they should come to some better understanding with the Council before incurring the heavy expenditure incidental to the construction of electric tramways within their district. An interview is sought.

Liverpool.—An electric car collided with a cart on Saturday. Results: horse down, cart overturned, driver fractured ribs and severe shock to system.

Runcorn.—The District Council has received a letter from Messrs. Bennett & Ward Thomas, consulting engineers, Manchester, with reference to promoting a scheme of electrical trams under the Light Railways Act, between Weston, through Runcorn, Norton, Acton Grange, Moore, Walton Inferior, and Warrington. They asked whether such a scheme would receive the assistance of the Council in any application which might be made to the Board of Trade. The Council decided to support the scheme.

South Lancashire.—This tramway scheme was referred to at a meeting of the Worsley District Council on Monday. The General Purposes Committee reported that they had passed a resolution approving of the proposal. The Council endorsed the Committee's report, and will support the scheme subject to terms.

South Staffordshire.—On Tuesday, at the Board of Trade, Sir Courtenay Boyle heard an appeal against an order of the Light Railway Commissioners for the construction of the South Staffordshire Light Railways, about 4 miles in length, connecting with the Wolverhampton tramways. The objectors to the scheme were the Corporation of Wolverhampton, represented by Mr. Lloyd, Q.C., the town clerk of Wolverhampton, and Mr. Pritchard, and the promoters by Mr. Sydney Morse and Mr. W. Sellon. Mr. Lloyd, Q.C., said the objection was on the preamble of the order, on the ground that the provisions of the Light Railway Act had not been complied with. There were numbers of tramways within the borough, and amongst them was the Dudley and Wolverhampton line. The policy of the Corporation had been, in recent years, to obtain control over the tramways within their borough, and they were now negotiating for the purchase of those tramways. Negotiations had also taken place with the promoters of the South Staffordshire Light Railway, who had got the present light railway order against the opposition of the Corporation.—Sir Courtenay Boyle: But you have had a hearing before the Light Railway Commissioners, and how can you object now?—Mr. Lloyd: Because they have introduced junctions which were not in the order before the Light Railway Commissioners.—Mr. Morse: The line would be no use without these junctions.—Sir Courtenay Boyle decided that there was no power under the order to make a physical junction with the Wolverhampton Corporation Tramways, and therefore it could not be done without the consent of the Corporation. If special application should be made to the promoters afterwards, the Corporation would be heard as to whether junctions should be made, but there was no power under this order to make physical junctions with the tramways without the Corporation's consent.—Mr. Sydney Morse mentioned that the promoters were supported by the Bilston and Coseley local authorities against the contention of the Wolverhampton Corporation.—The appeal of the Corporation was upheld, and any future negotiations between the parties as to junctions must be confirmed by the Board of Trade.

Walsall.—At Tuesday's Council meeting the town clerk was instructed to make formal application to the Staffordshire County Council, the Urban District Councils of Brownhills, Handsworth, Perry Barr, and Willenhall, and the Parish Councils of Bentley, Great Barr, and Rushall, for their consent to the Corporation laying the tramways in their districts, as proposed by the Walsall Corporation Bill, and a committee was appointed to deal with any matters arising in connection therewith.—The General Purposes Committee submitted to the Council for approval the agreement entered into with the various companies concerned for the acquisition of the tramways by the Council. The substance of this agreement was published in the Electrical Review of last week. The Mayor moved a formal resolution for the purchase of the tramways at £18,500. The resolution was carried.

Warwick and Leamington.—The Tramways Joint Sub-Committee recommends the respective Councils of Warwick and Leamington to exercise their powers with a view to the purchase of the Warwick and Leamington tramway, and working the same by electric traction, either by the Corporations themselves, or under lease to a company. The Leamington Council adopted the report on Monday.

Worcester.—The City Council has now voted by 29 votes to 10 in favour of granting a lease of the tramways to a company. The British Electric Traction Company has been in the field for some time past.

TELEGRAPH AND TELEPHONE NOTES.

Cardiff Telephones.—Some correspondence has passed between the town clerk and the Postmaster-General with reference to the taking over of the Post Office telephone system. A letter has been received from the manager of the National Telephone Company calling attention to the reductions which they proposed to make in the charges from January 1st next. The Postmaster-General referred to the efforts made by the National Company to secure new subscribers, and, therefore, the question of the Corporation taking over the National system for the Cardiff area, including, if necessary, the Rhondda and Monmouthshire Valleys, was a matter of urgency. A special meeting of the Parliamentary Committee has been called to consider the question.

Dover Telephones.—The Corporation has been invited to a conference of municipalities, called by the Municipal Corporations Association, to consider the question of the facilities for municipal telephones granted under the new Act, and also to a conference of towns in Kent and Sussex, at Hastings.

French Cable Projects.—The French Press is at present much exercised and grieved to find that, in communicating with the French colonies, in almost every case English-owned cables must be used. Various charges of injustice are brought against the English companies owning these lines, and as might be expected from the quarter from which these charges spring, they are not warranted by fact. That the need of a French network of cables is seriously felt, and is being taken up by influential people, there can be no question. A well-supported *projet de résolution* was presented to the Minister for the Colonies, inviting him to study the question; and when replying to M. Etienne in the Chamber, the Minister, M. Decrais, presented his assurances that a Bill on colonial cables would shortly be submitted.—The *Bulletin Hebdomadaire des Postes Télégraphes et Téléphones*, in its issue of the 7th inst., says: "Great Britain will probably have cause to regret the censorship that has been established to prevent South African news from arriving in Europe. In France, as well as in Germany, public attention is becoming more drawn to the monopoly of extra European telegraphy which Great Britain possesses. On the 27th ult. M. Henrique Dalue, and several of his colleagues in Parliament, brought before the Chamber of Deputies a resolution to the effect that the Chamber of Deputies should invite the Government to immediately consider the state of telegraph communication now existing between France and her Colonies. The proposed Bill is accompanied by documentary statements on the actual state of the French submarine telegraph system, and with these statements are others pointing to the urgent requirements of the country. These requirements may be shortly stated, taking them in their order of importance and urgency, as:—

"1. An arrangement for a line between France and Senegal.

"2. The establishing of an independent system between Europe and Madagascar.

"3. The connection of French Indo-China with the lines of the Great Northern Telegraph Company.

"And later—

"1. The establishment of lines connecting Senegal with the French possessions of West Africa.

"2. The construction of a line from Indo-China to Djibouti."

The *Evening Standard* of last Saturday stated that in the Chamber of Deputies (on the preceding day) a debate took place on the Colonial policy of France. M. Etienne, referring to the fact that all the submarine cables are in the hands of English companies, said this placed France in an inferior position, which was unworthy of her. It was indispensable that the country should have direct telegraph communication with the French colonies. Mr. Decrais, the Colonial Minister, interposing, said the Government would very shortly present a Bill to Parliament concerning the creation of these lines of telegraphic communication. This announcement, which was heartily applauded, would, M. Etienne declared, calm much patriotic uneasiness.

Glasgow Telephones.—The town clerk of Glasgow has sent to the Postmaster-General a general specification of the outline of a telephone system suggested for employment within the Glasgow telephone area.

Grantham Telephones.—The *Municipal Journal and London* states that Major-General Webber has been appointed "consulting engineer for telephones" to the Town Council of Grantham.

Imperial Telegraphic Communication.—At a meeting convened by the Liverpool Chamber of Commerce on Monday, Sir Edward Sassoon, M.P., delivered an address on "Imperial Telegraphic Communication." Since 1894 the Chamber has taken an active part in the agitation for a reduction of the cost of cables to India and other parts of the Empire. It maintained that the reduction of rates to India should be 1s. per word. Half measures would not do at all.

A resolution was passed recommending that support should be given to the action which the Imperial Telegraph Committee of the House of Commons proposes to take with the view of placing the important matter of communication between the United Kingdom, India, and the British colonies and dependencies on a footing commensurate with the greatly altered conditions of Imperial and colonial relations. The Mayor suggested that, in order to reduce Indian rates 50 or 75 per cent., the Indian Government should guarantee cable companies against loss.

Sir E. A. Sassoon delivered an interesting speech, the following report of which is abstracted from a fuller report in Tuesday's *Times*. He

said that their presence was a protest against one of the most gigantic impositions to which, perhaps, any civilised community had yet had to submit. For a great many years past the burden of the excessive charges had been felt by all the constituent portions of the Empire. At the instance of Mr. Henniker Heaton, 50 members approached the Chancellor of the Exchequer. It was he who granted the subventions which had enabled the associated group of telegraph companies to acquire the powers which they had, and which enabled them to impose their terms upon a long-suffering community. They laid the matter of onerous tariffs before him, and he expressed himself in absolute agreement with them, and admitted that, at any rate with regard to India, there is a very considerable grievance in the cost of telegraphic communication, and a good deal might be done in various ways to improve the position. He had an interview with the French Minister of Posts and Telegraphs, who assured him of his personal adhesion to the principle for which they were contending—viz., that the full inland rates of the two countries should not be exceeded. He gave the following instances of the charges he protested against. A good many messages for India and even for Australia *viâ* India were despatched through the landlines abutting on the Persian Gulf, and a word to Fao, at the head of the gulf, cost 6½d., but from there to the Indian frontier the charge went at a bound to 3s. 6d. London to Gibraltar, the same distance as Fao to Karachi, 3½d.; to Vancouver, 6,000 miles, 1s. 6d.; to Accra (Gold Coast), same distance, 6s. 3d.; to Alexandria, same distance, 1s. 7d.; to Perth (W. Australia), 11,100 miles, 4s. 7d; to Bombay, 6,300 miles, 4s.; to Borneo, 9,500 miles, 5s; to Lagos, 5,200 miles, 7s. 1d.; to Tunis, 1,400 miles, 2d.; to Bermuda, 2,900 miles, 2s. 6d. The working expenses were now so low, thanks to the duplex and Morse systems, which economise time, that in Queensland they could telegraph 3,000 miles for 1d. Another instance—St. Petersburg to Vladivostock, 6,000 miles, 4½d., whereas to Shanghai, a few hundred miles further, they paid 5s. The charge to Australia only a few years ago used to be 9s. per word, but after the reduction to 4s. and 4s. 9d. per word, all the preliminary sacrifice of revenue was recouped in three years. In South Africa, the dread of competition brought about a wholesome change in the attitude of the companies. In the case of India, the telegraph companies, he said, held India paralysed in their grasp, so that, however willing the Indian Government might be to meet reasonable demands, it could not be done, as that Government was apparently the bond-slave of these all-powerful companies. Why had the Indian Government remained passive and quiescent spectators for so long? Why was the landline connecting Constantinople with Cairo so inaccessible to the public? Why were the Turkish landlines along the Euphrates Valley equally inaccessible to them? If they could not have free trade in telegraphic communication, if they must suffer from the effects of some necessary protection to the companies, let them not sit still and, with folded hands, submit to this pernicious and all-absorbing system of bounty-fed lines and cables. They were very much in the dark as to the nature of the conventions entered into by the associated companies with the Turkish, Persian, Egyptian, and Indian Governments; and the Foreign Office refused information, on the ground that the permission of the companies would have to be previously obtained. This permission did not appear to be forthcoming. What was it they were afraid of divulging to the public? Why all this sinister and nebulous concealment, if everything was plain and aboveboard? Was it right or proper that on a matter affecting the welfare of their commerce, their shipping, and their industries, arrangements should be concluded and kept secret? They were consequently driven to grope in the dark in their efforts to wrestle with powerful corporations thus bolstered up and protected. He instanced the strong position to which the companies had attained, and their disregard of the public interest. Before the Folkestone Chamber of Commerce he had referred to the breakdown of the cable between Delagoa Bay and Mozambique—one of a system for which the proprietary company had received over £1,300,000 from the State in the shape of subsidies. This cable, although laid 20 years ago, had not been duplicated, and was interrupted from October 31st till November 15th last. A few days after its restoration came the news of another interruption of more than a week's duration between Aden and Zanzibar, to another unduplicated cable laid 20 years ago. Both of these were lines upon which they had to depend for the rapid transmission of news from the seat of war, and when these were interrupted they were only able to get news by the long landline through Natal to Cape Town, and so home along the West Coast of Africa cables. Were they not entitled to ask to what uses those public funds, so lavishly supplied, had been devoted? Was it understood that these subsidies were to be applied, however indirectly, towards buying out or expropriating accessible landlines in other parts of the world for the deliberate purpose of smothering and strangling competition, instead of being employed to keep the cables so freely subsidised in a state of efficiency by timely duplication, so that in the hour of need they might be of service to the nation? The rates of the companies, though they were reasonable when the enterprise was in its infancy, were now, in view of the phenomenal increase of traffic, wholly antiquated and intolerable. With the awakening of the constituent elements of the Empire to the necessity of drawing closer together to the mother country, a demand had arisen for facilities for the transmission of messages of a social character. A good deal of the toleration shown by the public towards these companies was undoubtedly attributable to the belief:—(1) that they were in possession of "all-British" cables; (2) that these cables were altogether beyond the reach of danger in time of war. He was afraid that the intelligent British public had lulled themselves into a false sense of security, for not only were these companies' cables not "all-British," they were not even mainly fixed on British landings, the bulk of them were switched on at Lisbon, Madeira, St. Vincent, Egypt, Java, and other foreign territories, and, as regarded their vulnerability, he had pointed out in letters to the *Times* that several cables were easily cut by the American men-of-war, and in some cases, as in the case of Hong Kong to the Philippines, cable communication was wholly interrupted, Admiral Dewey having had no difficulty in performing the operation. In the House of Lords, Lord Carnarvon stated in 1885 that "the Russian Government had a carefully elaborated scheme for taking measures against our submarine cables in Eastern waters." Sir John Ardagh, Director of the Military Intelligence Department, distinctly pointed out "that in the event of our losing Egypt, or anything happening in that country averse to our interests, the Mediterranean cables to Australia, India, and the East generally would be cut at once." This actually did occur during the bombardment of Alexandria. So much for these two pleas. The scheme which they proposed for immediate consideration, and for which they claimed their support, was not an ambitious one. A very simple way of overcoming the difficulties was pointed out in an excellent paper read before the Society of Arts by Mr. E. O. Walker, C.I.E., who was lately in the service of the Indian Government Telegraph Department, and this project it was which they recommended to their attention. The map showed that the Russian landlines to Merv were continued until they reached the north-west frontier of Afghanistan at Kouschk (about 70 miles north of Herat); from Kouschk *viâ* Herat and Kandahar and Afghanistan, Chaman in British India (in the vicinity of Quetta) was reached, a total distance of, say, 450 miles. A landline could be erected between Kouschk and Chaman, which latter formed part of the Indian telegraph system, for about £30,000. Now, the cost of a telegram from London to Kouschk was only 6d. per word if sent direct *viâ* Russia, and the cost of a telegram from any one part of India or Burma, to any other part was 2d. per word; to this total of 8d. they had to add the amount due for transit through Afghanistan, say, at most 4d., and in this way they could hope to see the rate to India reduced to 1s. per word. This line would meet the conditions of the Meshed to Herat route, of the possibilities of which Lord Curzon, from his experience of the country, spoke favourably, as since the time of his visit the Meshed line, which formed portion of the Persian landline system, had been connected with Merv, and thus with Kouschk. Authorities were also united as to the facility with which the Persian Gulf cables, which formed such an expensive link in the chain to India, could be reinforced by the establishment of a landline from Shiraz to Jask, in Persia, which, if erected (and its erection was estimated to cost about £35,000), would complete the overhead line from London to Calcutta, with the exception of the short cable across the Channel. It was in this way that they might hope to see the present high rates to India reduced. Having thus reached Burma at the rate of 1s. per word, let them turn their attention further East. Here they found that the Burmese lines reached down the Malay Peninsula as far as Mergin. A gap of 200 miles existed between this point and Penang, from whence a line runs south to Durian Saral, followed by a gap of 60 miles to Jelebu. From Jelebu the line to Malacca already existed, and a distance of 150 miles from Malacca to Singapore was still unbridged. Thus, by the erection of some 450 miles of landline, Singapore could be reached for about 1s. 6d. per word, provided that the Afghanistan line also were established. It was to the accomplishment of the project sketched out above that he earnestly directed their attention and claimed their support. All they asked for was fair play and bare justice. The fates were propitious, the arguries encouraging, and with their intelligent sympathy, aye, with their earnest, strenuous, and unfaltering support, they should before long record a great and a beneficent triumph.

A second resolution passed on the motion of Lord Darby was:—"That copies of the resolution be addressed to the Premier and other Ministers, urging that an early day be set apart for discussion in Parliament of the position of the telegraph companies in relation to the Government, with a view to remedying serious grievances, and that the members of Parliament for Lancashire be invited to support this action."

The Pacific Cable.—Last Tuesday the *Times* correspondent in Ottawa telegraphed that considerable impatience is manifested by the Canadian press respecting the inaction of the home Government in the Pacific cable question. It is pointed out that the colonies have chosen their representatives on the board of control, but nothing has been done because the Imperial members of the board have not been appointed. The Toronto *Globe* attributes the delay to the action of the Eastern Extension Telegraph Company. We are inclined to agree with this latter opinion. Delay is of great advantage to the Eastern group of companies, as in this way they not only retain the very large revenue derived from Australian traffic, but may hope to obtain the right to establish collecting offices of their own throughout Australia. The effect of such an establishment would, of course, to a very large extent, give the Eastern Extension the right of sending all telegrams not marked *viâ* Pacific over their own lines, and it is this right which they are so anxious to obtain. It is to be hoped, however, that the colonies concerned can easily understand how much the granting of such a right would damage the receipts of the Pacific cable, which these colonies have agreed to support. We notice that the Postal Commission of Western Australia does not appear to be entirely satisfied with the service given by the Eastern Extension Company, if we are to judge by one of the principal recommendations which they laid before the Assembly; it runs as follows:—"That the Government approach the Eastern Extension Telegraph Company with a view to improving the West Australian service, so as to remove the causes of complaint as to mutilation and delay in the transmission of cables."

Reading Telephones.—The Reading Town Council is asking for additional trunk line telephonic communication with London. There are at present two trunk lines to Reading.

(*Continued on page 971.*)

HEREFORD CORPORATION ELECTRICITY WORKS.

Owing to several applications having been made by private companies, in the year 1897 the question of applying for a provisional order for the electric lighting of the city of Hereford was considered by the Gas Committee, whose report in favour of such a step being taken was adopted; subsequently the Finance and General Purposes Committee on December 14th, 1897, submitted to the Town Council a preliminary report by Mr. T. L. Miller, A.M.I.C.E., of Liverpool, estimating the cost of an installation to meet the present requirements at £24,196, including generating plant for 6,000 8-c.p. lamps connected, with the requisite feeders, distributing mains, service connections, and road work.

Engine Room, Looking towards Switchboard.

A provisional order was applied for and duly obtained in 1898, when a Special Committee was appointed to consider the matter, of which Councillor W. J. Humfrys was elected chairman. Upon its recommendation it was decided to introduce a municipal supply of electricity in the compulsory area (High Town) and in several other central streets.

Numerous works were visited, including those at Westminster, Shoreditch, Leyton, &c., by the Committee, which, it is needless to say, received every courtesy from the various Councils and their officials.

From information it was able to obtain, the Committee unanimously came to the conclusion that the low tension system of distribution was the most suitable for Hereford, provided that a central site could be obtained for the generating station at a reasonable cost.

After many inquiries it was ascertained that a plot of land near the Cattle Market was for sale, and in view of its central situation and exceptional suitability for the purpose, a purchase was effected at the satisfactory price of £1,650.

The city surveyor was then directed to prepare plans and specifications of a scheme, the details of which were fully considered by a sub-committee consisting of the chairman (the present Mayor) with Alderman Symonds and Councillor Hewitt. Tenders were invited, and it was decided to accept that of the India-Rubber, Gutta-Percha and Telegraph Works Company, of Silvertown, to supply and fix the entire generating plant inclusive of boilers, engines, dynamos, switchboard, battery and cables, but exclusive of buildings, trenching and brickwork, for the sum of £11,230 12s. 5d. The accepted tender for the buildings was that of Messrs. W. P. Lewis & Co., Hereford, for £2,241; chimney, £461; and lightning conductor, £50; that of Messrs. Alexander and Duncan, of Leominster, being accepted for the constructional ironwork for £394. The formation of the roads, the drainage, laying cables, &c., were carried out by the Corporation workmen; together with the cost of site, meters, legal charges, &c., this involved an outlay of £5,600, bringing the total up to £19,926 12s. 5d.

The station buildings have been erected from the designs and under the supervision of the city engineer and surveyor,

Mr. John Parker, A.M.Inst.C.E. They comprise a boiler house 50 feet × 44 feet; engine room, 30 feet × 39 feet; and an accumulator room 30 feet × 44 feet, an old printing works being converted into offices, testing room and workshops.

The boiler house faces the main entrance from Widemarsh Street, and is substantially built of local pressed facing bricks, with Ruabon terra cotta dressings. Space is provided for three Lancashire boilers, two only of which are included in the present installation.

The chimney, which is octagonal in shape, is situated at the south-east corner of the buildings, and is 85 feet high. It is 5 feet internal diameter, and the outside measurement of the square base is 12 feet, the foundation being of cement concrete 23 feet square and 3 feet deep. The firebrick lining extends 33 feet high, with a ventilated air space between the firebrick and the outside shaft. The cornices and capping are of terra cotta. The lightning conductor is in duplicate, with a corona, to which are attached eight points and a rod of copper 5 feet long, with four points. The vertical tapes are 1½ inches × ⅛ inch, earthed in pits 20 feet clear of the buildings.

Throughout the buildings the roof trusses are of mild steel, and the covering is of Portmadoc slates on battens, with felt laid on diagonal boarding, the skylights and lanterns being glazed with Hopes' patent glazing.

The steel boilers, which were supplied and erected by Messrs. R. Taylor & Sons, of Marsden, Yorks, are of the Lancashire type, 30 feet long, and 7 feet 6 inches diameter, and are fitted with Meldrum's patent forced draught furnaces. The working pressure is 160 lbs. per square inch; the feed water is obtained from two three-throw pumps, driven by Silvertown motors, in addition to which one injector is provided. The feed water tank has a capacity of 600 gallons.

The economiser is of Green's standard 96-tube type, and is fitted with a patent self-acting triple scraper, which is driven by a motor through worm gearing.

The engines, two in number, are of the Belliss compound two-crank type, 9 inches and 5 inches × 9 inches stroke, each capable of developing 150 B.H.P., with a steam pressure of 155 lbs. at the engine stop-valve, when exhausting into the condenser or the atmosphere, and at a speed of 450 revolutions per minute.

Each engine is fitted with a throttle valve governor, worked direct off the crankshaft, and at the official test, when the full load was suddenly removed, the permanent variation was only 11 revolutions on No. 1 engine, and 8 on No. 2.

Each engine is coupled direct to a Silvertown undertype shunt wound dynamo, with drum bar armature, giving an output of 200 amperes, 440 to 500 volts, at the normal engine speed.

The dynamos when tested after a six hours' run at full load showed no signs of sparking at the brushes, and the maximum increase of temperature was found to be considerably under the specified rise of 70° F. The steam consumption of each of the combined sets at full load when condensing did not exceed 22 lbs. per E.H.P.-hour.

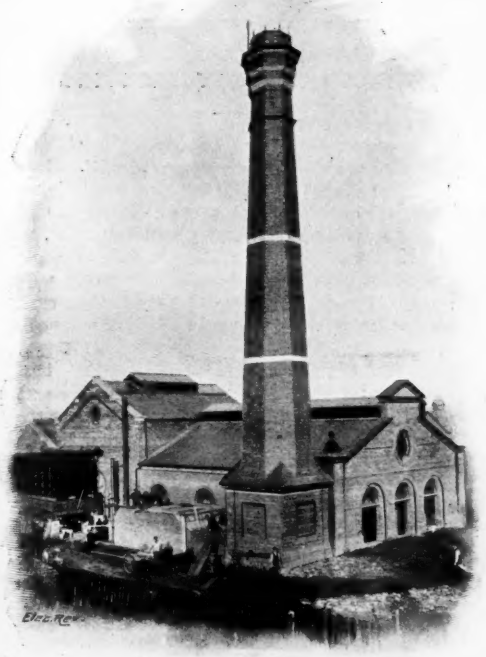
General View of Engine Room.

The main steam piping is of lap-welded steel, 8 inches diameter, with flanges forged on solid, the subsidiary steam piping being of wrought-iron, and the last bends to the engines of solid drawn copper 4 inches diameter.

The drain pockets on the main steam range, two in number, are provided with steam traps of the "Sirius" make. The exhaust pipes are carried in a trench below the floor level. The main exhaust, which is 10 inches diameter, is divided into two mains, each provided with a valve; one leads to the condenser, the other to the atmosphere, the latter running up outside the engine room wall to about 4 feet above the roof.

The condenser is of the "Ledward" evaporative type,

and is capable of dealing with 6,000 lbs. of steam per hour; it consists of 160 tubes, and is built outside the engine room upon girders, resting on a cast-iron water tank 25 feet ×



Hereford Electricity Works.

13 feet × 2 feet deep, to which are connected the electrically-driven air and circulating pumps inside the engine room.

All steam, hot feed, and exhaust pipes in the engine and boiler rooms are covered with sectional magnesia covering.

A 10-ton crane, by Messrs. Marshall, Fleming & Jack, of Motherwell, is provided to run the whole length of the engine room.

The balancer is made by the Silvertown Company, and is of their S D 40 type, capable of supplying 100 amperes to either side of the three-wire system at any voltage between 220 and 270 volts.

On either end of the balancer is coupled a booster of S D 10 type, capable of carrying a current of 90 amperes at any voltage between 20 and 90 volts. The combined set runs at a speed of 800 revolutions per minute, and is capable of working for any length of time without stopping, being fitted, as are the main dynamos and all the motors, with an arrangement for automatic continuous lubrication.

The switchboard is arranged for a three-wire supply at a pressure between the outers of 440 to 500 volts, and consists of three enamelled slate double panels carried by an iron frame measuring 14 feet × 8 feet. On the two outer panels are mounted the dynamo automatic cut-outs, with double-pole fuses, ammeter omnibus bars, feeder ammeters, and duplex fuses; and on the middle panel are mounted the battery regulating switches, balancer, double-pole starting switches, throw-over switches, and ammeters, and the voltmeters and multi-way switches.

Provision is made for four feeders, of which three only are in use at present; each feeder has both positive and negative duplex fuses with mica screens, ammeter and bus bars common to all feeders.

A middle-wire bus bar, provided with terminals for the battery, feeder, and balancer, is fitted, as well as an ammeter to indicate the amount of current flowing in the middle wire. Arrangement is made for connecting the middle wire to earth through an ammeter reading up to 50 amperes. Weston voltmeters are fitted on the feeder circuits, and Kelvin multi-cellular instruments for the dynamos, batteries, and boosters.

For starting the balancer and booster a double-pole switch is provided on the switchboard, with suitable starting resistances, and shunt resistances for the dynamos, balancers, and boosters are fixed under the platform, with their regulating switches on the switchboard hand-rail. A separate switch for breaking the exciting circuit of each booster is also provided.

The shunt circuit of the main dynamos is so arranged as to be interlocked with the automatic cut-out, so that the latter cannot be closed until the shunt circuit is made, and the shunt circuit cannot be opened before the main circuit is broken by the automatic cut-out.

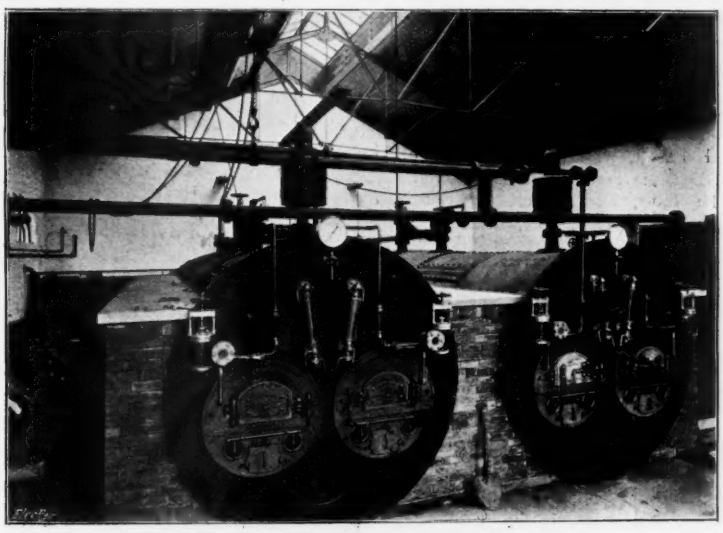
The accumulators are of the Chloride R type, in glass boxes, 270 in number, and have a capacity of 660 ampere-hours when discharged in nine hours; the battery is capable of discharging at the rate of 250 amperes without injury to the cells. It is fixed in two tiers in a spacious accumulator room, very lofty, and well ventilated; 40 cells in each half of the battery are connected by means of lead-covered cables with a 21-way regulating switch on the main board, so that the cells are cut in or out in pairs. The floor of the battery room is of cement, and is drained to the centre for cleaning purposes.

The main feeders and distributors were all made and supplied by the Silvertown Company. There are at present three feeders, "A," running to Commercial Street, 450 yards long, ·25, ·15, ·25; "B," running to the end of Broad Street, 750 yards long, ·25, ·15, ·25; "C," running to the corner of Eign Street and Victoria Street, 650 yards long, ·2, ·1, ·2.

There are 11 disconnecting boxes at various points in the city, some of which are provided with fuses.

The cables are insulated with vulcanised India-rubber, protected with tape all over, and are laid under the roadway in wooden troughing filled in with bituminous compound. They are designed for a pressure of 220 volts at the lamps, and are of such capacity that the rise and fall in pressure shall not exceed 4 per cent. in the distributing mains when the proposed full load of 10,000 8-c.p. lamps is attained.

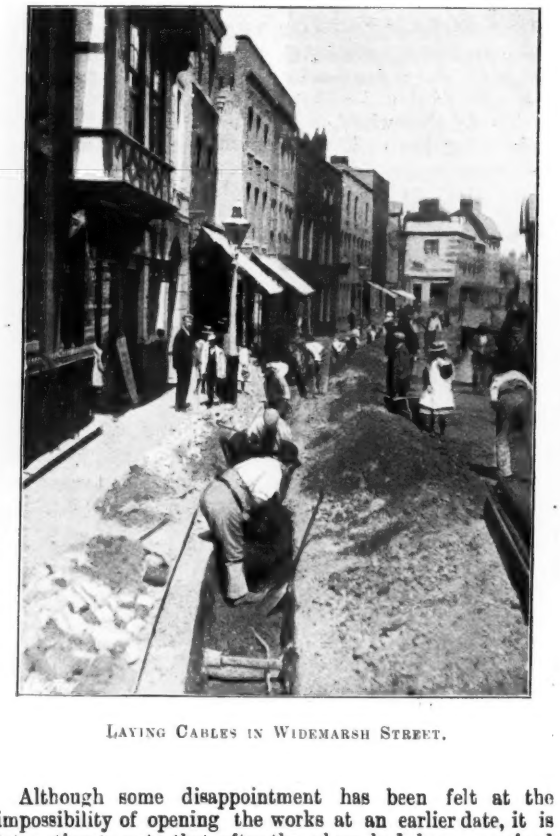
The length of the three feeders is approximately one mile, and distributing mains have already been laid to the extent



Boiler House.

of about 2½ miles. On commencing the work of cable laying the Corporation issued a circular expressing their willingness to make free service connections for all consumers who made application while the mains were being laid, and as a result they have already connected up premises representing 3,006 8-c.p. lamps.

The scale of charges has been fixed at 6d. per unit for the first two hours and 4d. afterwards on the maximum demand principle, the uniform charge for power being 3d. per unit.



Laying Cables in Widemarsh Street.

Although some disappointment has been felt at the impossibility of opening the works at an earlier date, it is interesting to note that after the plans had been examined by the Committee and finally approved, it was only on April 28th in the present year that the sanction of the Local Government Board was obtained to the necessary loan, thus leaving an interval of only 7½ months between this date and the formal opening yesterday.

The time occupied in construction, although exceeding the time specified, is almost a record one; the only instance in which an electrical installation of this magnitude has been erected in so short a period of time being that of Greenock, which was carried out by the same contractors in seven months 10 days, and which was opened on November 30th.

As it was, the result would have been better had not some delay arisen due to the difficulty in obtaining materials.

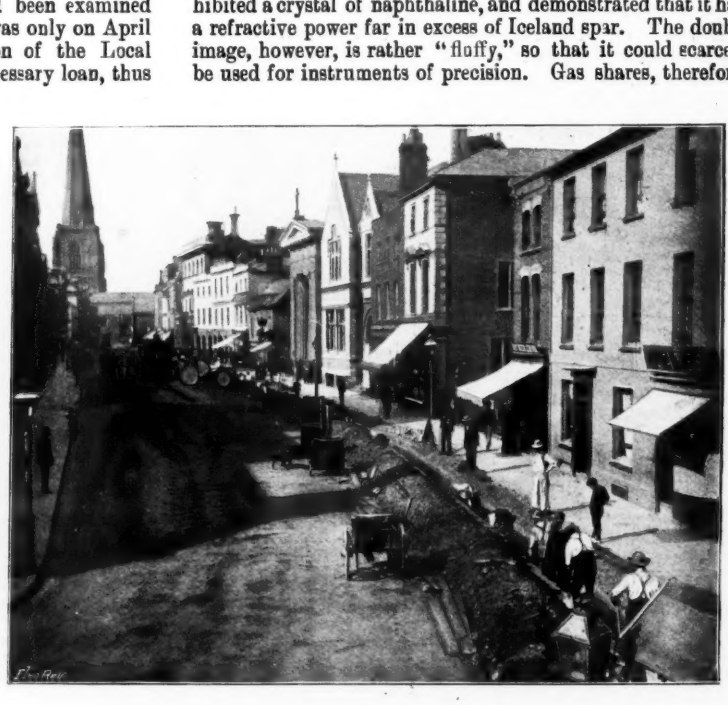
The whole of the work, excluding buildings and excavation, has been carried out by the India-Rubber, Gutta-Percha and Telegraph Works Company, of Silvertown, under the supervision of Mr. Stuart Russell, their local representatives being Messrs. Ely and Whitmee.

The Electricity Committee, whose able and energetic chairman is now Mayor, is to be congratulated on having been able to avail itself of the services of its engineer and surveyor, Mr. John Parker, who has already carried out many improvements in the town, amongst others a sewage works and a refuse destructor, which gives most efficient results; Mr. Parker carried on the work of the electricity supply unaided until Mr. F. G. Poulton was appointed to assist him.

We have to thank Mr. Parker for the photographs of the works which we have here reproduced, as well as for copious information regarding the electrical works and the city itself. We are indebted, also, to the Silvertown Company for particulars of the plant with which they have furnished us.

PHYSICAL SOCIETY MEETING.

The last meeting of the year was held at the City Guilds' Technical College, Finsbury, when Prof. S. P. Thompson was both host and lecturer. His paper on "Cylindrical Lenses" was listened to with a great desire on the part of the audience to follow the mathematical argument, and no doubt Lord Kelvin succeeded in doing it. But the majority of those present certainly did not. For when a mathematician has been pegging away at a problem, perhaps for weeks, and has become familiar with its various aspects and equations, so that he knows the physical meaning, and can predict the consequence of each step in the process, it's no good trying to keep pace with him during those brief and breathless moments when he is "explaining" it on the blackboard. Indeed, it is not courtesy to him to attempt to do so. Of course, it would be kinder of him merely to give you the results of his labours, and to leave you to follow the arguments when they are published in printed form; but if he insists upon making the grand tour, you have nothing for it but to sit still and wait till he is satisfied. Prof. Thompson's paper was concerned with the case of obliquely-crossed cylindrical lenses, such as are used by opthalmic surgeons for detecting and for correcting astigmatism. By a very neat application of a geometrical principle, and a graphic construction, Prof. Thompson arrives at a simple solution whereby he can determine the equivalent sphero-cylindrical combination for almost any system of obliquely-crossed cylindrical lenses. His paper should be much appreciated by the recently organised "Optical Society." As the result of an observation made by one of his students, Prof. Thompson then exhibited a crystal of naphthaline, and demonstrated that it had a refractive power far in excess of Iceland spar. The double image, however, is rather "fluffy," so that it could scarcely be used for instruments of precision. Gas shares, therefore, will probably not go up much on account of this discovery. Prof. Blakesley's paper was also upon "Optics"; indeed, it is probably one of the most important contributions that this branch of Physics has received this year. It is a continuation of his work, published in June, 1897,



Laying Cables in Broad Street.

on "A New Definition of Focal Length," but so far as could be gathered from his short account on Friday, he has arrived at some most valuable generalities, especially as regards the focal lengths of telescopes and the measurement of the refractive indices of liquids. The last item on the programme was a dynamometer exhibited by Prof. Dalby, chiefly interesting to us as an indication of the good work that is being done at Finsbury Technical College. The discussion on these papers might have been brilliant, but the readers of papers were determined to talk out the time. And they did.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 966.)

The Interruptions to the Cape Cables.—Our readers will recollect that Mr. Chamberlain in receiving a deputation representing the Eastern group of cable proprietors, pointed out that when any trouble arose in South Africa their cables were sure to break down. A proof of this is that last month the Mozambique-Delagoa cable was interrupted for a fortnight, and after its restoration the Aden-Zanzibar cable broke down for a week, thus for three weeks last month the East African route was useless to us. When addressing the Liverpool Chamber of Commerce last Monday Sir Edward Sassoon pointed out that neither of these cables, although they were laid 20 years ago, has been duplicated, and that the Eastern and South African Company which owns these cables has, besides its earnings, received State subsidies to the amount of £1,300,000. Yet Lord Tweeddale before the Pacific Cable Committee insisted on the necessity of duplications and triplications as instanced by the action of his own companies. This was meant to show that it was absolutely necessary that the Pacific cable if laid must be duplicated. During the present month the East Coast of Africa lines being fortunately restored, we find that the West Coast cable broke down last Monday, and we can only hope that the East Coast route will hold out till the cable at present broken (St. Thomé to Loanda) is put in working order.

A representative of the *Globe*, on inquiry at the offices of the Eastern Telegraph Company on Tuesday last was informed that there was no occasion for alarm at the present time. The break being on the West Coast route, it did not affect the company to the same extent as when it was on the East Coast, which line was now working satisfactorily, and was capable of doing more work than the other route. In reply to further questions, our informant could give no possible reason for the recent breaks, but added that it was merely extreme bad fortune. However, he was hoping that the line would soon be repaired, as the repairing ship, which was fortunately near San Thomé when the interruption was reported, left last evening for the scene of the break, and is expected to be on the spot by Friday. On inquiry whether the interruption was likely to cause any considerably delay in the receipt of telegrams from the seat of war, our representative was informed that there would probably be some delay in Press telegrams, but not in official messages.

The Postmaster-General and the Telephones.—A sitting of the Railway and Canal Commission was held in the Glasgow Court of Session on 5th inst. for the purpose of giving judgment on the difference which had arisen between the Postmaster-General and the Corporation of Edinburgh in connection with the request of the former for the latter's consent to the laying of underground telegraph lines under certain streets within the city of Edinburgh. The Corporation refused their consent, and the matter was remitted to the Sheriff of the Lothians, who decided in favour of the Postmaster-General. The Corporation appealed to the Railway Commission, who have now affirmed the decision of the Sheriff, and given consent to the proposal of the Postmaster-General. The Commissioners held that the case was substantially ruled by their decision given against the Corporation of Glasgow.

Salford Telephone Service.—The Town Council last week passed a report of the Finance Committee on the subject of telephones, in which it was recommended that—

In continuance of the support previously given to the Mutual Telephone Company, Limited, with a view to creating competition in the telephone service of the borough, the Council should undertake that in the event of a license being granted to the company, they will grant to the company wayleaves for underground wires, provided the company will within three months enter into an agreement with the Corporation to accept all such clauses and conditions as may be considered necessary or desirable by the Corporation.

The Finance Committee wrote to the Manchester Corporation asking whether Manchester would form a joint sub-committee with Salford to consider the desirability of establishing a municipal telephone service. The only reply was a note from the town clerk enclosing a copy of the resolution passed at the last meeting of the City Council referring the telephone question to a special sub-committee.

South African Telegraphs.—The report of the British South Africa Company issued at the end of last week contains the following references to the telegraph system:—

The telegraph system is being rapidly extended. On September 30th, 1898, 62 telegraph offices were open. Of these 17 were in the Bechuanaland Protectorate, 12 on the African Trans-Continental Telegraph Company's lines, and 12 on the British South African Police Telephone lines. At the same date the Rhodesia telegraph system, including the African Trans-Continental Telegraph line, consisted of 2,635 miles of line with 3,613 miles of wire. New telegraph lines are in course of construction. The African Trans-Continental Telegraph line has already proved of great value, both to the Imperial Government and the British South Africa Company, in assisting to maintain an effective control over the administration of the territory north of the Zambesi. The Imperial German Government has recently agreed to the extension of the line from Abercorn northwards through German territory to British East Africa.

The Telegraph Wire Export Trade.—Although the figures are not quite so large as was recorded a month ago, quite an unusual state of activity is just now prevailing in the export trade of this country in telegraph material and apparatus connected therewith. The returns just to hand for November show a total of no less than £260,239 which compares with £369,243 in the preceding month, and only £39,837 in November, 1898. The unusual heavy returns of the past two months have largely swelled the export figures for the 11 months ending with November last, these showing a total of £1,360,811, which compares with only £976,558 in the corresponding period of last year, and £828,962 in the first 11 months of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Saint Thomé-Loanda	Dec. 11, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines... ...	Oct. 30, 1899 ...	Dec. 9, 1899
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Indo-European lines between Odessa and Kertsch	Dec. 11, 1899 ...	Dec. 11, 1899
Indo-European lines between Odessa and Kertsch	Dec. 12, 1899 ...	...

Telephonic Communication on the Continent.—Telephonic communication will before long be established between Vienna and Constantinople, according to the Vienna correspondent of the *Chronicle*. The Hungarian and Servian Governments have just arranged for a telephone wire between Buda-Pesth and Belgrade, which is expected to be working at the end of January. From Belgrade the Servian Government has granted two more telephone wires, one to Sofia and another *vid* Uskub to Constantinople. There is a telephone already working between Buda-Pesth, Vienna, and Berlin. It may be expected that the German capital will soon have telephonic communication with Constantinople.

Wireless Telegraphy.—At the meeting of the Technical Society of Naval Architecture in Berlin last week, Prof. Slaby delivered an address upon "The Application of Wireless Telegraphy in the Navy," which was illustrated by many interesting experiments. Prof. Slaby paid a tribute to the French inventors who were the originators of the system, to the Russian, M. Popoff, and to Signor Marconi. The lecturer described how he had been enabled to observe the results which Signor Marconi had obtained two years ago, and how, working on that basis, he had succeeded in obtaining independently practically the same results Prof. Slaby has been supported in his investigations by the Emperor, the Aeronautic Society, and the Imperial Marine Department. The lecturer stated that the consideration of the tactical value of these discoveries must be left to professional sailors, but pointed out that there were no serious difficulties in the way of their practical application.

Worsley Telephones.—The District Council has approved of the application of the Mutual Telephone Company to establish telephones in the Council's district.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bedford.—The Electric Light Committee wants tenders for one 420-B.H.P. inverted compound double-acting engine, and one 250-kw. alternator. See "Official Notices" this week.

Bermondsey.—January 13th. The Vestry wants tenders for the construction, &c., of a dust destructor, with furnaces, water-tube boilers, economiser, fans and forced draught appliances, in connection with the electricity supply undertaking. See "Official Notices" to-day.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" November 24th.

Blackpool.—December 15th. The Corporation wants for the electricity works four boilers and accessorial steam plant; two 600-KW. steam alternators (or one 1,200-KW.), switchboard, mains, transformers, and battery. See "Official Notices" November 24th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" November 24th.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Hull.—December 28th. The Electric Lighting Committee wants tenders for two 750-H.P. high speed three-crank vertical engines; and two 460-KW. continuous current dynamos (2,250 volts) for the Sculcoates Lane electric lighting station. See "Official Notices" December 8th.

Ilford.—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-KW. and one 100-KW. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" to-day.

Manchester.—December 16th. The Corporation Tramways Committee wants tenders for steel tie-bars, bolts and nuts for permanent way work. See "Official Notices" December 1st.

Manchester.—December 30th. The Tramways Committee wants tenders for 450 electric tramcar bodies. See "Official Notices" to-day.

The Midland Corporation.—December 18th. From an "Official Notice" Nov. 24th, particulars may be obtained of certain plant and machinery and conductors, for 10,000 B.H.P. output, required for the new power house to be erected by the Midland Electric Corporation for Power Distribution, Limited. There will be 16 water-tube boilers, six sets of Corliss engines and three-phase generators, transformers, switchboards, mains, batteries, &c.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

St. Annes-on-the-Sea.—December 21st. The Urban District Council wants tenders for mains, street arc lighting (enclosed globes), and street incandescent lighting. See "Official Notices" December 8th.

Shoreditch.—December 19th. The Vestry invite tenders for the construction of two underground transformer stations in Great Cambridge Street and Queen's Road respectively. Particulars and forms from Mr. J. Rush Dixon, Town Hall, Old Street, E.C.

Wallasey.—December 20th. The District Council wants tenders for a Lancashire boiler for the electricity works. See "Official Notices" December 8th.

West Bromwich.—December 22nd. The Corporation wants tenders for boilers, steam dynamos and condensers, switchboard, mains, and storage battery, for electricity supply. See "Official Notices" December 8th.

CLOSED.

Bootle—In connection with the laying of a double line of tramways in Knowsley Road, the Town Council gave Messrs. R. W. Blackwell & Co., Limited, the order for the complete equipment of the overhead trolley line, and Callender's Cable and Construction Company, Limited, London, were entrusted with the supply and laying of the cable for the Knowsley Road lines.

Boston.—Mr. J. E. Lester, electrical engineer, Leicester, has received orders for a private electric light plant of 225 8-C.P. lamps, with accumulators, in the new factory of the Boston Cigar Manufacturing Company, Lincolnshire.

Glasgow.—Messrs. D. Bruce Peebles & Co. have secured the contract for the whole of the electrical equipment for the motors for driving condensers, air pumps, circulators, &c., at the Corporation tramways station. This contract was placed by Messrs. Mirrlees, Watson & Yaryan.

Llandudno.—The following is a list culled from *Tenders and Contracts* of some of the estimates submitted to the District Council for the supply of three 150-KW. high speed engines and dynamos, motors, and boosters.—

Lancashire Dynamo Company	£3,632
India-Rubber Company (Allen Engines)—(*accepted*)	4,022
Thames Ironworks Company	4,197
General Electric Company	4,427
J. H. Holmes & Co.	4,848
Scott & Mountain	4,894
W. H. Allen, Son & Co.	4,9 7
Smith & MacMillan	4,971

Sixteen other tenders were received ranging from £5,028 to £6,606.

Wolverhampton.—*Tenders and Contracts* gives the following list of tenders submitted to the Corporation for the supply of two 500-KW. direct coupled generating sets for the electricity works:—

T. Parker, Limited (Parker-Belliss)	£10,681
Ditto (Parker-Willans)	10,582
Ditto (Parker-Allen)	9,974
Electrical Construction Company (E.C.C.-Belliss)	10,189
Ditto (E.C.C.-Willans) (*accepted*)	9,920
Ditto (E.C.C.-Allen)	9,541
Ditto (E.C.C.-Peache)	9,777
Willans & Robinson (E.C.C.-Willans)	10,028
Siemens Bros. (Siemens-Willans)	10,410
Brush Company (Mordey-Raworth)	10,981
Scott & Mountain (own)	9,637
F. Suter & Co. (Willans)	8,710
Ditto (Allen)	8,104
F. Nell (Ball & Wood)	9,897
C. A. Parsons (Parsons turbo-generator)	8,718

Wrexham.—The following is a list of the tenders submitted for the municipal electricity and dust destructor works. Consulting engineer, Mr. W. H. Trentham:—

SECTION A.—BOILERS AND DESTRUCTOR.

	£	s.	d.
Sterling Boiler Company	4,262	0	0
Morrin Climax	5,029	1	8
*Babcock & Wilcox	5,800	0	0

SECTION C.—SWITCHBOARD.

*Brook, Hirst & Co.	539	10	0
Edwards Electrical Company	593	10	0
Crompton & Co.	687	0	0
Luna Electric Works	750	0	0
Moon, Loughlin	750	0	0
James White	790	10	6
General Electric Company	803	10	0
Dorman & Smith	807	0	0
Veritys	819	0	0
Cowans	820	0	0
Fowler, Lancaster	875	0	0
Edison-Swan Company	915	0	0
Electric Construction Company	1,025	0	6
British Thomson-Houston Company	1,123	8	0
Heywood	1,141	0	0

SECTION D.—MAINS.

*St. Helens Cable Company	4,499	11	7
Callender & Co.	5,290	4	7
General Electric Company	5,486	18	4
Brooke, Hirst & Co.	5,411	0	0
British Insulated Wire Company	5,446	19	6
Western Electric	5,526	7	6
Henley's Telegraph Co.	5,582	17	5
Glover & Co.	5,726	4	10
Sidge, Ryman & Graesser	6,488	12	9

SECTION B.—STEAM DYNAMOS.

Lancashire Dynamo Co.	Allen engines	6,471	10	0
" "	Alley-Maclellan engines	7,260	10	0
* " "	" "	7,422	10	0
" "	Belliss "	7,829	10	0
" "	Reavell "	6,697	10	0
" "	Willans "	7,786	10	0
* " "	Lawrence-Scott dynamos	6,658	10	0
Reavell	Thames Ironworks "	6,878	10	0
"	G. E. C. "	6,961	10	0
"	Thos. Parker "	7,056	10	0
W. H. Allen & Co.	Allen engines	7,031	0	0
Thos. Parker	" "	7,459	0	0
"	Alley-Maclellan engines	8,333	0	0
"	" "	8,307	0	0
"	Belliss engines	8,627	0	0
"	Willans "	8,759	0	0
Blackwell	Parsons "	7,661	15	0
Crompton	Peache "	8,047	0	0
Electric Construction Co.	Allen "	8,201	0	0
" "	Belliss "	9 513	0	0
" "	Willans "	9 659	0	0
Ashton, Frost	Belliss "	8,380	0	0
Ernest Scott & Mountain	Own "	8,610	0	0
Johnson & Phillips	Peache "	8,660	0	0
British Thomson-Houston	Belliss "	8,711	8	0
Sandycroft Foundry Co.	Willans "	9,076	0	0
Mather & Platt	" "	9,147	0	0
" "	Belliss "	9,177	0	0
Silvertown India-Rubber Co.	" "	9,540	0	0
" " "	Willans "	9,795	0	0
Brush Electrical Eng. Co.	Raworth "	9,664	0	0
Maclure & Whitfield	Reavell "	9,644	17	0
Alley-Maclellan	Own "	10,339	0	0

SECTION F.—ACCUMULATORS.

*Chloride Company	991	0	0
Marquand	1,162	13	6
Electrical Power Storage Company	1,550	0	0
Hart Battery Company	1,653	0	0
Tudor	1,812	0	0
D. P. Battery Company	2,035	0	0

SECTION G.—CRANE.

*Carrick & Ritchie	140	0	0
Watford Engineering Works	149	0	0
Carrick & Sons	150	0	0
Jas. Spencer	150	0	0
Higginbottom & Mannock	168	0	0

* Recommended for acceptance.

Hospital Lighting.—We understand that dynamos by Bruce Peebles & Co. and Willans engines have been adopted for the generating plant for Guy's Hospital.

FORTHCOMING EVENTS.

Tuesday, December 19th.—At 8 p.m. The Institution of Civil Engineers. Further discussion on "Combined Refuse Destructors and Power Plants," by C. Newton Russell, Assoc.M.Inst.C.E.

Thursday, December 21st.—At 2 p.m. The Institution of Civil Engineers. Students' visit to the Generating Station of the Westminster Electricity Corporation, Eccleston Place, S.W.

RE OUR ARTICLE ON ACCUMULATORS AND VEHICLES.

THE Electrical Power Storage Company, Limited, the owners of the Faure-King patents and the manufacturers of accumulators of that type, which were supplied to the London Electrical Cab Company, Limited, complain of the following statements in our article headed "Accumulators and Vehicles," of last week.

They (the Cab Company) seemingly took up a cell which, according to their own tests, was quite inadequate to the needs of a cab service. Presumably the reasons that led the directors to adopt this accumulator were the somewhat handsome terms for maintenance offered by the Accumulator Company. Whatever the reasons may have been, it is said that the conditions of maintenance were not fulfilled, and, with the absolute failure of the accumulators, it was only a matter of time before the cabs were taken off the streets.

The E.P.S. Company assure us that the above statements are erroneous, that their accumulators worked satisfactorily, and were, in fact, at work, and were fulfilling the terms of the contract at the time when the operations of the Cab Company ceased. It is, therefore, incorrect to suggest that the failure of the cab company was due to any failure of the accumulators, or to any failure on the part of the Electrical Power Storage Company to fulfil the conditions of maintenance. Accepting this information as *bonâ fide*, we have pleasure in publishing this correction, and in expressing our regret that this paper has been the medium of circulating the injurious statements referred to.

NOTES.

Electric Motors and Printing Machinery.—During the course of his presidential address to the Newcastle Association of the Students of the Institution of Civil Engineers some days ago, Mr. J. H. Holmes gave some interesting notes on the application of electric driving in printing works. The *Newspaper Owner*, in an abstract, says that Mr. Holmes had been assured by one firm of letterpress and general printers and lithographers, who had adopted the system of driving independent machines by separate electric motors, and who had 74 such motors at work, that the output from their works had increased at least 20 per cent. since the introduction of electric driving. Mr. Holmes attributes this increase of output to six different causes:—

(1) The readiness of an electric motor, as compared with other prime movers, to respond to any demand made upon it for power above its normal load. (2) Its uniformity of speed ensures more perfect register of the printed matter, and wastes are few and far between. (3) The absence of spoilt sheets caused by drops of oil from the overhead shafting and bearings, or by dirt carried round by the belting. (4) The more accurate adjustment of speed, which is possible with a motor (by means of a regulating switch), than with the usual three or four step cone pulley for belt driving. (5) Electric driving of machines is so much steadier, that they can be run at higher speeds without excessive vibration. (6) The main engine, which is usually a slow running one, invariably decreases its speed somewhat when there is a sudden increase of load, caused by more machines being started, or by the running machines happening to get into step and synchronising. In such cases, also, he says the main driving belt is sure to slip.

The Enclosed Arc Lamp.—Those who followed the open and enclosed arc lamp controversy a few years ago will be interested in an article by Mr. L. B. Marks in the *Electrical World and Engineer*, in which he gives statistics showing the relative use of open and enclosed arcs supplied from 36 central stations, including those of the New York, Boston, and Brooklyn Edison Companies. Most of the arcs installed by these companies are operated on direct current constant potential circuits. In some cases a separate service is maintained for constant current high tension lamps. The relative use of the two types of lamps by eight lighting companies is graphically represented in curves. The progress of the enclosed arc lamp is notably marked in the cases cited, which include New York, Chicago, Brooklyn, Boston, Detroit, New Orleans, Washington and Indianapolis. Mr. Marks says:—

1. That the year 1895 marks a notable turning point in arc lamp practice, brought about by the introduction of the enclosed arc lamp.
2. That the use of the open arc type of lamp is rapidly declining.
3. That the enclosed arc is superseding the open and also greatly extending the arc lamp field. This is borne out by the fact.
4. That the total number of arc lamps in use in each year shows a remarkable increase over the preceding year.

The statistics show that the progress of the enclosed arc was relatively slow up to 1896. The number of open arcs in use that year was greater than in 1895, but dropped rapidly in 1897, and more rapidly in 1898 and 1899. The records for 32 cities in 1896 and 1899 respectively are as follows:—

Number of open arc lamps in use 1896	23,605
Number of enclosed arc lamps in use 1896... ...	1,203
Total	24,808
Number of open arc lamps in use 1899	16,010
Number of enclosed arc lamps in use 1899	20,848
Total	36,858
Decrease in three years, open arcs ...	over 32 per cent.
Increase in three years, enclosed arcs	over 1,600 "
Increase in three years, total arcs ...	almost 50 "

It is estimated that there are now in use in the United States about 150,000 enclosed arc lamps, of which more than half have been installed within the past two years. This record, says Mr. Marks, is probably unequalled in the annals of arc lamp installation the world over. Statistics obtained from reliable authorities show that the total number of enclosed arc lamps in use in Europe (Great Britain and the Continent) is approximately 55,000, or only a little over one-third of the number credited to the United States. It should be stated in this connection, however, that the first commercial use of enclosed arcs abroad began about a year later than in America. Although the output of enclosed arc lamps during the past two years has been phenomenal, there are no indications of diminishing popularity. On the contrary, now that the transmission of electrical energy by alternating currents is coming more and more into favour, the field for arc lamp use will, Mr. Marks believes, be correspondingly enlarged. The output of enclosed alternating arcs during the coming year promises to greatly exceed that of the past, and in time to equal if not surpass that of the direct current type.

Appointments Vacant.—The Bradford Corporation wants an engineer to take charge of the electricity department at £500 per annum. See "Official Notices" to-day.

The Plumstead Vestry is inviting applications until 21st inst. for the appointment of electrical engineer to design and take charge of electricity works at £400 per annum.

The Brighouse Corporation wants applications for the appointment of consulting electrical engineer for the borough. The Doncaster Corporation wants various hands for the electricity works. See our "Official Notices" this week.

Royal Institution.—The Friday evening meetings for 1900 will begin on January 19th, when a discourse will be given by Lord Rayleigh on "Flight"; succeeding discourses will probably be given by the Hon. C. A. Parsons, Prof. J. H. Poynting, Prof. Dewar, and a number of other gentlemen.

The Berrenberg Lamp.—Our readers will remember some correspondence which appeared in our pages about a month ago, in which we were scolded for criticising certain statements issued by the makers of the Berrenberg lamp. At the time, the Berrenberg Lamp Company sent us a dozen lamps, in order that we might form our own conclusions as to their merits. We have submitted 10 of these to an absolutely impartial test of initial candle-power and efficiency, with the results given below :—

BERRENBERG LAMPS.

Tested at 100 volts.

Maker's stamp.	Candle-power.	Amperes.	Watts per candle.
100 volts, 16-C.P.	9·8	0·38	3·88
"	9·8	0·38	3·88
"	9·8	0·38	3·88
"	10·5	0·40	3·81
100 volts, 32-C.P.	21·7	0·80	3·69
"	22·4	0·78	3·48
"	25·2	0·80	3·17
"	25·2	0·80	3·17
"	21·7	0·77	3·55
"	21·6	0·76	3·52

It will be noticed that the candle-powers obtained are in each case about two-thirds of the marked values ; perhaps, if these lamps were run at about 106 volts, they would give their marked candle-powers at, of course, higher efficiencies. To do this, however, is irrelevant ; the consumers, who are most interested in the matter, have to take what is supplied to them as regards both the voltage at their terminals and the lamps they use, and hope for the best. As it is, we fail to see where the two watts per candle superiority over other lamps comes in.

Of other five lamps of the same make marked 200 volts, 16 C.P., tested at 200 volts, the best gave 11 C.P. at 3·45 watts per C.P., the worst 7·8 C.P. at 5·0 watts per C.P. These results were, however, communicated to us, and we take no responsibility for them.

Newcastle-on-Tyne Local Section of the Institution of Electrical Engineers.—A meeting of the local members of the Institution, and of others interested in electrical science, was held in the Durham College of Science on Wednesday evening, December 13th. The president of the Institution, Prof. S. P. Thompson, D.Sc., F.R.S., several members of Council, and the secretary of the Institution, Mr. W. G. McMillan, who had travelled down from London, were present. Mr. J. F. C. Snell, the temporary honorary secretary, read letters regretting inability to be present from the Duke of Northumberland, the Marquis of Londonderry, Sir David Dale, Bart., Sir Lindsey Wood, Sir Andrew Noble, K.C.B., the Bishop of Durham, the Dean of Durham, Prof. Weighton, C.E., Prof. H. G. Brady, Mr. John W. Swan, F.R.S., Mr. W. C. Mountain, the Mayors of Newcastle, Sunderland, and Darlington, and several other gentlemen, all of whom expressed the wish that the local section may be launched and be a success in every way. The President explained the objects of the association and the desire of the parent Institution to further the interests of district sections. Mr. John Holmes proposed, and Mr. J. A. Jeckell seconded, that a memorial be signed to forward to the Council. This motion was carried unanimously. There were 68 members present, and a provisional committee was formed, consisting of Hon. C. A. Parsons, Messrs. Holmes, Mountain, Heaviside, Snell, Jeckell, and Burnett. Votes of thanks to the Rev. Principal Gurney and the President concluded the proceedings.

Railway Station Lighting.—The L. C. & S. E. railway stations at Snow Hill, Ludgate Hill, and Holborn Viaduct are now lighted by arc lamps. The first named is probably the most villanous hole in the United Kingdom, but it is something to have lived for to see Jandus lamps installed there, making the platforms light as day, except when a G. N. train goes through. *Then*, and only then, are the arcs totally obscured by the smoke these engines leave in their wake. Anyhow, passengers have something to be thankful for since the almagamation of the L. C. and D. and S. E. companies have made it possible to at least clearly see one's way about the three stations named, two of which are a standing disgrace to London from a builder's or architect's point of view, while the third is not much better.

The Majert Accumulator.—In this accumulator the characteristic feature is the very large surface of the positive plate, which is of the Planté type. The negative plate is of the usual Faure type, in which red lead is plastered into the interstices of a lead grating. The surface of the positive lead plate is increased 12 to 14 times by forming on it a number of fine deep parallel ribs by means of a machine resembling the ordinary shaping machine. The tool of this machine acts like a plough, cutting from the lead plate a thin furrow at an angle, and bending it up into a perpendicular position. The surface of the plate when finished resembles the underside of the top of a mushroom. The durability of the plates of the Majert accumulator is very great. Twenty thousand positive plates have been in constant use for a year on the Great Berlin Street Railway, and only 18 of these have had to be replaced, *i.e.*, less than 1 per 1,000. Considering the wear and tear on accumulators used in electric traction, this is a remarkable result. The maximum charging and discharging currents of these batteries is also very high. A battery weighing about 20 lbs. has a capacity of 15 ampere-hours ; it can be discharged in a quarter of an hour with a current of 60 amperes, and can be charged with a constant current strength of 24 amperes, or at a constant voltage of 2·55 with a current of 84 amperes. A full account of this accumulator and its performances will be found in the *Elektrotechnische Zeitschrift*, November 9th, p. 783.

The Wehnelt Interruptor.—Starting from the experimental fact that the heat developed in a single cycle of a given Wehnelt break is constant, Dr. Simon deduces (*Wied. Ann.*, Vol. 68, p. 273) the following approximate formula for its action :—

$$T = \frac{3}{2}\frac{L}{r} + C_1\frac{r}{E^2} + C_2;$$

where L is the self-induction of the circuit, r the resistance of the layer of liquid surrounding the anode, which is converted into steam, E the impressed electromotive force, T the time of one cycle, and C_1 and C_2 are constants. The truth of this formula has been experimentally verified, partly by Dr. Simon himself (*Elektrotechnische Zeitschrift*, Vol. 20, p. 440), and partly by Ruhmer (l.c. 20, p. 786). To investigate the relation between the periodic time, T, and the working electromotive force, E, the above formula can be written in the simplified form $T = A + \frac{B}{E^2}$. The numbers calculated from this formula agree very closely with experimental results obtained by Simon. Ruhmer has made experiments to test the formula for the relation between T and the self-induction L. The simplified form of the formula in this case is $T = AL + B$. Ruhmer's experimental results also agreed remarkably well with those calculated by the formula.

Asylum Lighting.—An imposing range of buildings has recently been erected near Hendon by the board of the Central London Sick Asylums, the architects being Messrs. Giles, Gough & Trollope, of Craven Street, W.C. The whole installation for the lighting of the building was carried out by Messrs. Hampton & Sons, Limited, of Pall Mall East, who obtained the contract in an open competition to the specification of Messrs. Owen, Lucas & Pyke. There are about 900 lights at the asylum, the plant consisting of two steam dynamos, 37 KW., each driven by a Willans & Robinson's compound engine of 60 I.H.P. The dynamos are of Easton, Anderson & Goolden's make. There are two sets of 45 K 27 E.P.S. cells in parallel, coupled in series with 10 regulating cells of capacity equal to double the output of the K 27's. The main switchboard was made by the G.E.C., and consists of three separate panels—one panel for the "A" dynamo, one panel for the "B" dynamo, and the other panel for the battery. It is so arranged that either dynamo can charge the battery or run direct on to the lights. It is fitted with recording ammeter (Kelvin), Ferranti wattmeter, Prentice maximum and minimum cut-outs and three ammeters, three voltmeters, and regulating switch. We understand this is the first board to be fitted with the newest form of G.E.C. switch.

The Cost of Electricity from Isolated Plants.—It is generally assumed, says the *Engineering Magazine*, that electricity can be supplied to buildings more cheaply than it can be generated by isolated plants; but that this is not always the case is shown in a carefully prepared paper read before the American Institute of Electrical Engineers by Mr. Percival R. Moses. Mr. Moses has collected information from more than 100 buildings of various sizes and types, and from these he has selected those from which the information was furnished with such a degree of detail as to render the conclusions reliable. The buildings selected include hotels, office buildings, loft buildings, department stores, and apartment houses, all in the city of New York, and since liberal access to the books of the establishments were permitted, the data are of much interest. In the investigation of the buildings, the hourly variations in the demand for light and power were plotted in the form of curves, and in each case a proportional allowance made for depreciation, interest, and other fixed charges. A typical building was taken in each case, and as these cases include actual records of the cost of supplying the same buildings, under the same conditions, with electricity, both from their own isolated plants and by the central station, it certainly appears as if the comparisons have been made upon a fair basis. In considering the isolated plant it must be remembered that in nearly, if not all, such buildings a steam-power plant must be maintained in any case, or at least steam must be used for heating, and if the steam-power does not provide sufficient exhaust steam to warm the building, live steam must be used. The installation of an isolated electrical plant is therefore only a partial increase in operating expense in such cases, and not so great as it would be if the entire power plant had to be placed solely for the operation of the electrical machinery. We give here only the conclusions which Mr. Moses draws from each building considered by him, and the full data in each case will be found in his original paper. Taking a table which Mr. Moses has prepared for buildings using approximately from 825,000 KW.-hours per annum down to 40,000 KW.-hours, he shows that the costs per KW.-hour for isolated plants are as follows:—

Large hotel	1·66 cents.
Small hotel	2·45 „
Apartments	4·70 „
Department store	2·85 „
Small store	4·10 „
Large office building	4·37 „
Small office building	5·06 „
Loft building	2·60 „

When it is understood that the charges by the central station company, taken from the published reports, are, on an average, 10·6 cents per kilowatt-hour, and that the cost of production is about half this, it appears that under existing conditions in New York the private consumer can generate electricity at about the same cost, or even less cost, than the central company, and that there is a manifest economy in the installation of the isolated electric plant.

Electric Light Companies and Consumers.—Not content with issuing a circular dated 11th inst., regretting the necessity of discontinuing the electric supply to consumers on the following Tuesday and Wednesday during the hours of greatest demand, the Metropolitan Electric Supply Company followed this up by another on 13th inst., telling their customers it would not be possible to resume the supply at this period of the day until next Sunday, *it being impossible to complete the temporary repairs before that date.* It would be interesting to learn what these repairs are, and why they have become necessary, but on this point we can gather no information. We shall, however, deal with the whole question of electric lighting companies and consumers in our next issue on quite impartial grounds.

A Generous Grant.—Principal Reichel, of the Bangor University College, has received an intimation that the Drapers' Company, London, have resolved to make a grant of £600 towards the maintenance of the department of electrical engineering at the college.

Electrical Mishap at Westminster.—At a quarter to five on Tuesday evening an explosion occurred in the electric light culvert of the Westminster Electric Supply Corporation in Great Smith Street, Westminster, blowing up the pavement for several yards. The paving stones falling into the culvert caused the short circuiting of all the copper conductors, these, unfortunately, being several of the main feeders from the Millbank Street Station. The corporation men were on the spot shortly after this happened, and the short circuited mains were disconnected as quickly as possible. In the meantime, owing to the excessive current thrown on, the feeders running to Parliament Street, these caught fire, but there was no explosion, and *no* boxes were blown up. As soon as it was heard that smoke was issuing from the ventilators men were sent round to remove the covers, and the fire from the burning insulation on the cables was extinguished as quickly as possible. This is the first occasion since the Westminster Company commenced supplying that it has had an accident so serious as to practically extinguish the lights.

Personal.—We learn that Mr. Ernesto Danvers, M.I E E., of Buenos Ayres, has been elected president of the Institution of Engineers of the River Plate. He is shortly to read a paper on the "Progress of Electrical Enterprise in the River Plate."

Mr. J. J. Smith, of Altrincham, has been appointed resident engineer of the new electricity works of the Stockton Town Council at a salary of £250 per annum.

We are informed that Mr. C. P. Sparks (hitherto with Messrs. S. Z. de Ferranti, Limited) has joined the County of London and Brush Provincial Electric Lighting Company as chief engineer.

Lectures.—On 5th inst. Mr. Robert Hammond lectured at the Town Hall, Rathmines, on "Electricity in Relation to Public and Domestic Use." The lecture was delivered under the auspices of the Rathmines and Pembroke Councils.

On Thursday, January 10th, Prof. C. A. Carus-Wilson, M.A, M.I.E.E., will commence a course of lectures to the students of the Electrical Standardising, Testing and Training Institution upon "The Construction and Use of Motors."

Greenock Electricity Works.—From the wording of the third paragraph of the report of the opening of these electricity works, some of our readers have gathered the impression that the works in Greenock have been carried out from a report and designs prepared by Mr. Teague, of Paisley. This, we are given to understand, is an error, as Mr. Teague was not retained as consulting engineer at Greenock, although he gave a preliminary report. Mr. Fedden is the burgh electrical engineer.

The Royal Society.—Among the papers down for reading yesterday were:—Prof. J. A. Fleming, F.R.S., "A Note on the Electrical Resistivity of Electrolytic Nickel," and Dr. C. Chree, F.R.S., "Investigations on Platinum Thermometry at Kew Observatory."

The War Funds.—A most successful concert was given by the employés of Messrs. Siemens Bros. & Co. at the Drill Hall, Woolwich, on Wednesday last week, in aid of the Transvaal War Fund.

Electrical Haulage on Canals.—An installation of electric haulage over a distance of eight kilometres on the Charleroi Canal, Belgium, has just been completed and put in operation.

American Machinery in the United Kingdom.—The American Consul in Edinburgh is reported in a contemporary to have stated that many American machines are much more efficient than British machines as regards output, and he states that he has found large numbers of American machines at work. Certain printing or folding machinery is instanced, also some rope machinery, but he appears to have fallen into the error so common with all American writers, that we ought to do so much better here in competition, because American wages are so very much higher—he states 70 to 90 per cent. We are much inclined to doubt this. We have made comparisons when possible, and have often found the reverse to be the case without making any allowance for the greater cheapness of living here than in America. On this point also the difference is becoming less, and comparing towns of about equal size, we think that comparatively little difference exists either way. Our home manufacturers have not, therefore, the advantage of low wages so frequently stated, but there appears a desire on the part of American writers to magnify the prosperity of the workman in America. At one time, this was done by the tariff men to a ridiculous extent, but at the present moment even Americans are a little tired of the cry that they can beat the world in open market, and yet the high tariff is necessary to do this. The high-tariff trick is seen through, and American competition would have come much sooner than it has done if high tariffs had not existed. Considering their large areas, the immense natural resources of coal, iron and copper, and other things, it requires the high tariff to be used as an explanation why America has not done more. The vested interests which are such bars to progress here have no counterpart in America. Land is in plenty, and new towns will offer special facilities and endowments in the shape of freedom from taxes to people establishing works.

The New York Metropolitan Railway.—In describing last week the 3,500-KW. generators at present being installed at the power station of the Metropolitan Street Railway Company, New York City, we omitted details of the engines driving these. These engines were made by the E. P. Allis Company, of Milwaukee, for whom Messrs. R. W. Blackwell and Co. are the European representatives. The principal dimensions are: cylinders, 46 inches and 92 inches diameter; stroke, 60 inches. The total weight of the engine is approximately 625 tons. The fly-wheel is 28 feet diameter, constructed in 10 segments, and weighs approximately 100 tons. The crankshaft weighs 41 tons. The engines are designed to consume 13 lbs. of steam per I H P. per hour.

Car Mileage.—The proper estimation of car mileage was one of the subjects dealt with at the recent Chicago Convention. Most companies computed mileage from the conductor's reports, and fully half the replies to a circular letter showed that the mileage of every car was kept. In computing mileage, there is a doubt as to the propriety of including or excluding the distance from the car shed to the line of traffic, the dead mileage which tells against a road if it be not included. The author of the paper discussed was Mr. Mackay, of Milwaukee, and he would include this dead mileage if only that it would tend to discourage badly placed car sheds. The car day is usually 18 hours, which corresponds with English practice. It appears from the discussion that the car-mile basis of accounting is not quite universal, and that there is a basis of car hours. The treatment of trailers also is not standard. Some count trailer mileage; some take no account of the trailer, and generally with all the experience that has been gained on American tramways, the methods of accountancy appear far from fixed. It appears to us difficult to take speeds into account. Comparing a city and a suburban line, each showing 1·0256 per car hour, the car-mile cost would be ·1282 and ·0427 respectively for speeds of 8 and 24 miles respectively, the speeds, of course, varying the results very much. The question admits of a good deal of argument, no doubt. There is some reason in accounting on the time basis, for is not interest on capital based on time; but again, receipts from passengers are based on distance. There is a desire evidently to secure some common basis for comparison that shall embrace all conditions. Cannot the car-mileage be multiplied by a speed coefficient to bring to a common basis? Obviously a rapidly moving car is earning more upon its cost than a slow car, and the car-mile basis, though so commonly used, may possess merely the fact of its being so easy to obtain as an excuse for its existence. At the same time, it seems to us that the car-mile basis is necessary in many ways. It is not of much use to know the car-hour earnings, it does not tell us much as to the condition of the car in regard to passengers. The car-mile figures do tell us this, and the car-mile will probably remain in English work at least to be a basis of computation.

NEW COMPANIES REGISTERED.

Adelaide Development Company, Limited (64,393).—This company was registered on December 2nd, with a capital of £25,000 in £10 shares, to adopt an agreement with the British Westinghouse Electric and Manufacturing Company, Limited, of the first part, Callender's Cable and Construction Company, Limited, of the second part, and H. Noyes, E. Noyes, and Noyes Brothers of the third part, and to carry on in Adelaide, South Australia, or elsewhere the business of tramway proprietors, electrical engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—L. H. Grundy, Claremont House, South Hampstead, N.W., solicitor; S. E. Appleton, 4, Haseldene Road, Harlesden, clerk; J. W. Ward, 14, Marney Road, Lavender Hill, S.W., gentleman; T. C. Richards, 23, Ingate Terrace, Queen's Road, S.W., gentleman; E. E. Ford, 12, Kylemore Road, West Hampstead, N.W., secretary; G. E. Eggleton, 10, Cheriton Square, Upper Tooting, S.W., secretary; and A. Booker, 19, Porters Road, Paddington, W., clerk. The number of directors is not to be less than three nor more than four; two are to be nominated by the British Westinghouse Electric and Manufacturing Company, Limited, one by Callender's Cable and Construction Company, Limited, and one by Noyes Brothers; qualification, one share; remuneration, £300 per annum, divisible. Registered office, Westinghouse Building, Norfolk Street, Strand.

Electric Light Insurance and Maintenance Company, Limited (64,399).—This company was registered on December 4th with a capital of £10,000 in £1 shares, to acquire the business of the Electric Light Insurance and Maintenance Company, Limited, to supply electricity, to lay down and maintain wires, cables, &c., and to carry on the business of an electric light company in all its branches, and any guarantee and insurance business (except life assurances). The first subscribers (each with one share) are:—A. Lood, 100, St. Martin's Lane, W.C., manager; H. E. Lowry, 100, St. Martin's Lane, W.C., clerk; J. B. Evans, 15, Douro Place, Victoria Road, W., engineer; D. Millist, 3, Norfolk Villas, Crouch End, Willesden, insurance agent; G. E. Wellington, 23, Ebury Street, Easton Square, engineer; F. Flower, 54, Silchester Road, Wormwood Scrubbs, W., clerk; and H. H. Lyde, 21, Gloucester Gardens, Hyde Park, W., solicitor. The number of directors is not to be less than three nor more than five. The subscribers are to appoint the first; qualification, £100; remuneration, two guineas each per board meeting attended (maximum, 50 guineas). Registered office, 100, St. Martin's Lane, W.C.

SUPPLY STATION ACCOUNTS.

Hull Corporation Electricity Accounts.

The accounts of the Kingston-upon-Hull electricity supply undertaking show very favourable results. The new station is probably the reason for the increase alike in capital expenditure, output, and revenue. The original, or Dagger Lane, works were opened in January, 1893, and were described in our columns at the time. The new, or Sculcoates Lane station was opened at the end of October, 1898, so that it assisted in coping with the heavy winter load. A temporary auxiliary plant in North Street dealt with the continually and rapidly increasing demand during the winter months of 1897.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£61,739	£94,959	£33,220
Number of units sold	467,352	749,690	282,338
Maximum KW. demanded... ...	687 KW.	1,075 KW.	388 KW.
Gross revenue	£10,419	£16,333	£5,914
Gross profit	£4,968	£8,328	£3,360
Average price per unit sold ...	5·12d.	4·98d.	−·141.

Hull is one of the towns in which the price has been maintained so as to effectively cover the cost of production, but the rapidly increasing load will, no doubt, reduce it this year well below the 5d. at which the unit approximately stands.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
ale of current	£9,967	5·12d.	£15,546	4·98d.	−·14d.
Meter rents	329	·17d.	456	·14d.	−·03d.
Supply of lamps, &c. ..	...	...	...	...	...
Sundry	123	·06d.	331	·11d.	+·05d.
Gross revenue ..	£10,419	5·35d.	£16,333	5·23d.	−·12d.

In the "costs" the increase in the "coal" item is no doubt due largely to the generally enhanced price of coal. The rise in "wages" may be accounted for by the fact that two stations are running, and the same remark might be made about "Establishment charges." Oil, waste, &c., remains unchanged, but, curiously enough, "rent, rates," and "salaries" have both fallen, the collective drop being nearly ¼.

Costs of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£1,096	·564.	£2,034	·65d.	+·09d.
Oil, waste, water and engine room stores.	170	·09d.	298	·09d.	...
Salaries and wages incurred in generation and distribution.	887	·46d.	1,581	·51d.	+·05d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,469	·751.	1,688	·54d.	−·21d.
Works' cost ...	£3,622	1·86d.	£5,601	1·79d.	−·07d.
Rent, rates, and taxes ..	756	·391.	845	·27d.	−·12d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	738	·381.	965	·31d.	−·07d.
General establishment charges, stationery and printing, law charges and insurance.	335	·171.	594	·19d.	+·02d.
Other expenses	...	...	...	...	...
Total costs ...	£5,451	2·80d.	£8,005	2·56d.	−·24d.

The gross profit has increased from approximately £4,970 to £8,330. Whereas in 1897 the interest and sinking fund charges amounted to about £2,970, these now absorb over £4,820, but the net profit has risen from £2,000 to £3,500, an increase of no less than £1,500, which indicates a particularly satisfactory state of affairs, and especially so if the capital charges on the new station have been fully paid.

Profit Statement.

	1897.	1898.
Interest on loans	£1 496	£2,267
Sinking fund for repayments	1,467	2,555
Net profit, carried forward	2,005	3,506
Gross profit	£4,968	£8,328

CITY NOTES.

Electric Light and Traction Company of Australia, Limited.

The statutory meeting of this company was held at Winchester House on Monday.

Mr. J. B. Braithwaite, jun., who presided, went briefly over the progress which had been made in the three months which had elapsed since the offer of the capital to the public. The whole of the 20,000 preference shares were allotted, the subscriptions being in excess of the amount offered. At a distance of 12,000 miles some time must necessarily elapse before they could get things into working order. They had appointed an engineer (Mr. F. W. Clements) whom they believed to be a man of exceptional ability, in whose hands the Australian operations would be perfectly safe. He is now in Melbourne actively working in the company's interests. The arrangements for the purchase of the two existing Melbourne supply companies had involved some delay, owing to the time occupied in communication with this colony, but that matter they believed had been carried safely through. The board last week cabled out the money to pay out the shareholders in the two companies, and by the end of the present month they would be actually in possession of the two stations in Melbourne, and Mr. Clements would be able to commence at once the concentration of the two works and the introduction of the various economies which it was believed would be effected by working the two concerns at one station. The prospectus stated that the Melbourne Corporation had come to an agreement to purchase the electric cables within their own boundary, and to pay some £40,000 in cash therefor. That arrangement is in course of being carried out. The Corporation had already fulfilled their part of the bargain, which was that in consideration of that they would use their influence to obtain for the company, and give their consent to, orders to light the exceedingly important suburbs of Melbourne for 25 years. The board had received information that this consent had been given and the orders granted, so that they might take it that they had now got the necessary legal rights for lighting those suburbs, and the payment of the £40,000 they were advised would take place in the course of the present month. By the beginning of 1900 they would be in possession of the two properties. The plant was already loaded to its fullest capacity, so that they were not in a position to supply additional lights at present. The board had taken time by the forelock, and had placed orders for an additional two 500-kw. generators, and those they hoped would be ready in time to enable them to push actively the suburban lighting. For a certain time they were to supply current to the Corporation, but they hoped that before that supply was taken off the company would begin its active propaganda in the suburbs, where the demand for current was great, in fact, unprecedented, for the engineer could load up his machines at once if he had them. This company was entitled to the profits, such as they were, of the two companies for the current year, and that would give an immediate source of income. Next year those results ought to be considerably improved. They had taken active steps to commence the Geelong supply at once. Plans for the lighting station had been approved, and authority given for the erection to be commenced. Orders had been placed for the plant, and they had fortunately secured plant exactly suited to their requirements. This plant had been ordered for a South American town some time ago, but owing to a hitch in the arrangements, this company was able to secure it and save several months in the time of delivery. The plant was nearly completed, and would probably be shipped in the current year, or early in 1900. The Geelong winter supply (May, June, and July) would be met by the company. Since the company was formed they had taken a rather important step. They had the opportunity of acquiring the property of the South Australian Electric Lighting Company, which had obtained rather exceptional legislative powers from the Colony of South Australia, including the right to light Adelaide, a city of some 200,000 population. This had been obtained, and formed a very important addition to the rights of this company. There was already a small station in operation at Port Adelaide, supplying a few lights, but that would probably be closed down and current would be furnished from Adelaide itself when the station was in working order. Thus they had the lighting of Adelaide, of "Greater" Melbourne, and of Geelong. Further, they were constantly having offers made to them of concessions in various other parts of Australia, and it looked as though their company was regarded as the most stable company in Australia, and they would have the offer of any concessions worth having. The statements of the prospectus were strengthened by the addition of the Adelaide lighting. Arrangements have been nearly carried through for securing a quotation on the Stock Exchange, and such would be obtained early in the new year.

Volenite, Limited.

The first annual general meeting of this company was held on 5th inst. at Dublin. Lord Lurgan, who presided, said that seven-eighths of the shareholders resided in Ireland. He referred to the balance-sheet and to the delay which had occurred in the completion of the works and the erection of the machinery. Mr. Lamplough, the inventor of volenite, had consented to take over the entire management of the business. Questions had also been addressed to them with regard to electrical volenite. They were now executing orders in connection with this branch of the business, but in order to deal with it fully they should have a large increase of capital. The present intention of the directors, owing to the reports which have been circulated and the distrust which apparently they have aroused, was not to come to the shareholders for further working capital until they proved to them what volenite was. They had been asked questions as to the cost of volenite, but owing to the numberless uses to which it was applied they could not tell the cost, and he did not think they would be justified in doing so. They had been criticised in the press in reference to volenite and as regards the non-existence of works. Well, he was afraid that the press had been misled. For the short time they had been running they got more orders than they could execute, and to enable them to deal with larger orders they would increase their plant, and that, of course, would involve further expenditure. That was a question which was giving the directors considerable anxiety. They wanted to avoid asking for further capital at present, and they had arranged with their bankers for an overdraft, so as to enable them to execute these orders. It might be necessary later on to ask the shareholders for further capital, but they intended not doing so until they had proved what they were doing. He had little doubt that the shareholders would then come forward with the necessary capital. If the shareholders expressed a general wish the directors were willing to increase the capital to £100,000 by a further issue of £20,000, but that rests entirely with themselves.

The report was passed unanimously without discussion.

Mr. Lamplough having handed round photographs of the works, and a catalogue containing a list of the articles they were turning out, said some people had been kind enough to write to him hoping they would see him standing in the dock. Well, that might be amusing, but it was not very encouraging. They had lately purchased additional plant, and were it not for that they could never have undertaken the large orders they had got. He was arranging with the people offering them to finance the venture by paying for the work as it was turned out.

The Chairman said they had received orders for volenite, in which a certain amount of rubber was required. Volenite, in its original state, had not a particle of rubber in it. Fish oil was used in the manufacture of volenite.

A Shareholder said it was stated by the late manager at the last meeting in Dublin that it was not.

Mr. Lamplough said considering that their late manager never made volenite, he did not see how he could know. They had an unlimited amount of raw material to work upon.

Calcutta Tramways Company, Limited.

The directors' report states that the negotiations with the Corporation regarding the proposed agreement for electric traction have now been brought to a successful conclusion. The principal conditions of the new agreement provide (*a*) that the company shall remain in undisturbed possession of their tramways for 30 years from January 1st, 1901, in consideration of the company converting the system from horse to electric traction within three years; (*b*) that the track rent payable to the Corporation for all lines now existing within their jurisdiction shall be the fixed sum of Rs.35,000 per annum from the date of completion of the electrical equipment; (*c*) that, in lieu of all existing rights of purchase, the Corporation shall have the right of acquiring the undertaking at the expiration of the above-mentioned period of 30 years upon paying 25 year's purchase of the average annual profits for the preceding seven years. If the right of purchase is not exercised at the expiration of the period of 30 years, it can only be exercised at the expiration of successive periods of seven years. The great difficulty in the way of satisfactorily working the undertakings hitherto has been the inadequate means of traction afforded by horses. The climatic conditions, the uncertainty of prices of forage due to recurring periods of dearth and famine, and the inability of the horses themselves to do the work required of them, have made it almost impossible to meet the requirements of the public. Now, however, the introduction of electric traction will obviate these difficulties. The directors propose to create an issue of £950,000 of 4½ per cent. first debentures, which they estimate will suffice (*a*) to redeem the existing £100,000 5 per cent. debentures; (*b*) to pay for the conversion to electric traction; and (*c*) leave a margin of capital available for extensions or for the general purposes of the company.

National Telephone Company.—The transfer books of the 3½ per cent. debenture stock of the National Telephone Company, Limited, will be closed from the 18th to the 30th inst., inclusive, for the preparation of the warrants for the half-year's interest due January 1st.

W. T. Glover & Co., Limited.—The debenture stock transfer books of this company will be closed from Saturday, December 16th, to Saturday, December 30th, both days inclusive, for the preparation of interest warrants.

Chelsea Electricity Supply Company.—The books will be closed from December 18th to 31st for payment of the interest on debenture stock.

Eastern Telegraph Company, Limited.—An interim dividend of 1½ per cent. on the ordinary stock, free of tax, for the quarter ended September 30th, is announced.

City Meeting.—A meeting of the India-Rubber, Gutta-Percha and Telegraph Works Company was held yesterday, and a report will appear next week.

Electrolytic Alkali Company.—Letters of allotment have been posted.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 9th, 1899, were £127 1s. 1d.; December 9th, 1898, £137 2s. 1d.; aggregate for half-year to date, £19,864 14s. 1d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 8th, 1899, were £2,630 19s. 7d.; corresponding period, 1898, £2,558 8s. 10d.; increase, £72 10s. 9d.

Buenos Ayres Tramways.—The receipts for the week ended November 18th show a decrease of £312.

The City and South London Railway Company.—The receipts for the week ending December 10th, 1899, were £1,110; December 11th, 1898, £1,117; decrease £7. Total receipts for half-year, 1899, £23,650; total receipts corresponding period, 1898, £23,763; decrease, £103. Miles open, 8¼.

The Dover Corporation Tramways.—The receipts for the week ending December 9th, 1899, were £145 6s. 5d.; December 9th, 1898, £142 9s. 5d.; increase, £2 17s. 0d. Total receipts to date, 1899, £9,609 0s. 7d.; corresponding period, 1898, £8,069 11s. 7d.; increase, £1,538 9s. 0d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,714; 1898, 4,181. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 8th, 1899, were as follows:—D. U. T. Co., horse cars, £129 5s. 10d.; ditto, electric cars, £2,814 19s. 3d.; D. S. D. Co., electric cars, £672 9s. 8d.; total, £3 616 14s. 9d.; corresponding week last year—D. U. T. Co., horse cars, £9,231 7s. 7d.; ditto, electric cars, £481 10s. 6d.; D. S. D. Co., electric cars, £650 11s. 10d.; total, £3,363 9s. 11d.; increase, £253 4s. 10d. Aggregate to date, £96,450 3s. 4d.; aggregate to date last year, £91,499 14s. 0d.; increase to date, £4,950 9s. 4d. Worked:—The mileage open is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, and 28 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending December 10th, 1899, were £581; December 14th, 1898, £285; increase, £296. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £21,727; 1898, from June 29th, 1898, £6,802. Miles of track open, 12; 1898, 3¼.

Hobart Electric Tramway.—The receipts for October show an increase of £45.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 10th, 1899, amounted to £1,453: corresponding week last year, £1,383; increase, £70; total increase for half-year, £1,883.

The South Staffordshire Tramways Company.—The receipts for week ending December 8th, 1899, were £670 10s. 9d.; December 9th, 1898, £599 17s. 4d.; aggregate receipts for 49 weeks £29,651 1s. 8d; 1898, £30,949 12s. 8d.

STOCKS AND SHARES.

Wednesday Evening.

Many people are asking why it is that war with the South African States should cause flatness in shares of Home industrial undertakings, or in companies whose operations are perhaps carried on at the other end of the world. Brokers are constantly receiving inquiries as to why electrical securities should be flat, or what has caused the fall in some of the telegraph descriptions, seeing that the companies' lines run to the Eastern hemisphere, right away from the theatre of war. The stereotyped answer is that the weakness is attributable to dearer money, a reply which means little or nothing to the average outsider, who can trace no connection between the Transvaal war, the dearness of money, and the dwindling away of the prices of his investments. We will venture to attempt a more comprehensive reply to the query than the busy broker has time to dictate.

War, like most other things nowadays, costs money, and is, in fact, the most costly luxury in which a nation can indulge. To raise the money recourse must be had to the nation, and in October last, when eight millions sterling was voted as a preliminary grant to the War Office, three-eighths of the amount was readily obtained from the money market and the Stock Exchange. This was the beginning of the dear money scare, which has now developed into a squeeze. The Bank Rate was doubled in very little more than a month, and as the news from the front gave evidence that the campaign would last considerably longer than was at first expected, it became apparent that considerably more money would also be wanted. This is the time of year when all the world's money markets are eager to obtain gold, and as the banks are now offering handsome rates for money on deposit, many people are selling their investments to place the proceeds with the banks. But a stronger reason for the fall is that dear money invariably induces a feeling of apprehension, which causes free selling in speculative departments, and losses incurred thereby have to be met by forced sales of higher class securities at the very time when dealers are nervous and have no buyers. There are, of course, other causes at work which lead to a decline in electrical and industrial shares at such a time as this, but those which we have outlined are the main factors. They are responsible, for instance, for the weakness in the supply market. However well the companies may be doing, their shares cannot withstand the effect of entirely foreign influences, and under the circumstances, an upward reaction cannot be expected until some idea is obtained as to when hostilities will be over, with a consequent relief to the money and stock markets generally.

Metropolitans are a particularly dull spot in the electrical supply section. There seems to be a muddle over the company's new works at Willesden, and the buyers who came along in November have got all the shares they required. The carrying-over rates in this department on Tuesday averaged from 7 to 9 per cent.

Electrical railway stocks naturally suffer badly in days of flatness, owing to the narrowness of the market. City and South Londons continue weak. We cannot say we are particularly surprised, for it must be remembered that the new branch to Moorgate Street, although on the point of completion, is not yet open, but the capital required for its construction has already begun to rank for dividend, which will naturally make a difference to the amount available for distribution on the old stock. Waterloo and City has lost strength on the fear that the agitation now on foot with regard to the overcrowding on the system may lead to the line losing traffic, which, we venture to think, is a needless apprehension.

In the country division, Bournemouth and Poole New Ordinary shares, issued at £1 premium, are quoted at £1 premium above the issue price, while the new Preference are nominally about 10s. premium. Seeing that the existing issue of Preference shares stands at 10½, there is certainly not much to be gained by subscribing for the new issue at the same price. The last day for applying is Thursday, December 21st.

Telegraph stocks are moving in the same direction as everything else. The fall in Anglo-Americans has been accelerated by a smart slump in Yankee rails. Eastern Ordinary was scarcely affected by the declaration of the usual quarterly dividend, but the money market has exercised the regular depressing effect. Moreover, the stoppage on one of the company's lines from South Africa was not an encouraging item for the bulls, who also were mulcted pretty heavily for contangoing their stocks to the end of the year. In other telegraph issues scarcely anything is doing, and business, on the whole, in the electric market is very slack.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Dec. 6th.	Closing Quotation, Dec. 13th.	Business done during week ended Dec. 13th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	65 — 68	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115½—116½	115½—116½	116⅜	115½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17 — 17½	16⅞— 17½	17 1/16	16⅞
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	14⅞— 15½	15¼	14⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104	103
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	¼— ¼	¼— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	8½— 9½	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜— 12¼	11⅜— 12¼	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	154 —159	150 —155	156	152½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	99⅞	98½
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	115 —120	116	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	15½— 15⅝	15 — 15½	15 9/16	14⅞
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	116 —121	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 8,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	101—104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11½— 11⅝	11½— 11⅝	11½	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 15⅝	15 13/16	15 9/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 33	31 — 33	...	...
89,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	50	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5¼	5 — 5¼	5⅛	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14¼	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5⅝	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	100¾	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	102 —105	102 —105	103½	..
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7¼	...
3,381	Submarine Cables Trust	Cert.	...	...	...	127 —132	126 —131	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	101½	100
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	¾ %	...	⅞— 1½xd	⅞— 1½	1	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	9½— 10 xd	9½— 9¾	9 11/16	9½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	7½— 8½xd	7½— 8½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	8 — 9	7½— 8½	8½	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	111 —113	111 —113	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	11½— 12½	11 — 12	11½	11¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅜	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	10½— 11½	10 — 11	10¼	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	111 —114	111 — 114	111½	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	2⅜— 3¼	2½— 3	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6 — 6½	5⅝— 6¼	5⅞	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14 — 15	13½— 14½	14½	13⅝
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13½— 14½	13½— 14½	...	...
230,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½— 16½	15½— 16½	15⅝	15½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4¼— 4⅝	4¼— 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	14 — 15	14 — 15	14⅜	14

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Dec. 6th.	Closing Quotation Dec. 13th.	Business done during week ended Dec. 13th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜ — 3¼	2⅜ — 3¼	2⅜	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½ — 17	16½ — 17	16⅞	16½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	12½ — 13¼	13 — 13½	13⅜	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½ — 12⅝	11½ — 12⅝	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½ — 6⅝	6½ — 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞ — 2⅛	1⅞ — 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅜ — 2⅝	2⅜ — 2⅝	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10⅛ — 10⅜	10⅛ — 10⅜	10⅛	10⅜
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	4⅜	...
71,447	Do. do. Def. do.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
630,000£	City and South London Railway	Stock	1⅛ %	1⅛ %	2⅛ %	61 — 64	61 — 64	62¼	61
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½ — 4¼	3½ — 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4	3½ — 4	3¾	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	3½ — 4½	3½ — 4½	4⅛	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	2⅛	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜ — 3¼	2⅜ — 3¼	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	10 — 12	10⅞	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	12½ — 13½	12 — 13	12½	12
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5¼ — 5⅜	5 — 5½	5 5/16	5¼
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3¼ %	3¼ %	8⅜ — 9	8 15/16 — 9 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼ — 13⅜	13¼ — 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 40	38	36
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10 xd	9 — 10	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 103—106.
National Electric Free Wiring, 10s. paid, 4s.—5s.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 1—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅜. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½ xd.
*T. Parker, £10 (fully paid), 18⅜.

Bank rate of discount 6 per cent. (November 30th, 1899).

MARKET QUOTATIONS, Wednesday, December 13th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a " "	per ton	£27	£27	..
a Bleaching powder	per ton	£6 10	£6 1	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4¼d.	3¾d.	¾d. inc.
a " Caustic (75/80 %) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
Crystals	per ton	£3	£3	..
a " Bichromate, casks ..	per lb.	3¼d.	2¾d.	1d. inc
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b " Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2° to 12°) basis	per lb.	8d.	8¼d.	¼d. dec.
c " Tube (brazed)	per lb.	10d.	10d.	..
" Wire, basis	per lb.	8¼d.	8¼d.	¼d. dec.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£85	£85	..
g " Wire (basis price) ..	per lb.	10½d.	10½d.	..
g " Sheet	per ton	£95	£95	..
g " Rod	per ton	£85	£85	..
a German Silver Wire	per lb.	1/8	1/8	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine ..	per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants)	per ton	From £11	From £11	..
i " Forgings, according to size	per ton	50/- to 55/-	50/- to 55/-	..
i " Scrap, heavy	per ton	£14 5	£14 5	..
i " Wire galvanised No. 8 ..	per ton	£17 10	£17 10	..
g Lead, English Ingot	per ton	£19	£19	..
g " " Sheet	per ton	£19	£19	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 10	2/6 inc.
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large	per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet	per lb.	From 1/2½	From 1/2½	..
c Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£59	£58	..
g Tin, block	per ton	£124 5 nom.	£124 5 nom.	..
g " foil	per lb.	1/7	1/7	..
n " wire Nos. 1 to 16	per lb.	1/10	1/11	1d. dec.
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. ..	per lb.	5d.	5d.	..
j " Hemp, 8 ply 10 lbs. ..	per lb.	3¾d.	3¾d.	¼d. inc.
j " " Russian, 10 lbs.	per lb.	4¼d.	4¼d.	..
j " Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£25	£25	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

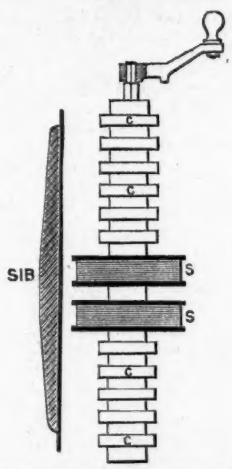
METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By Ernest Kilburn Scott, A.M.I.C.E.

(Read at Manchester, Tuesday, December 5th.)

(*Continued from page* 946.)

The Oerlikon Series Parallel Controller.—In this controller the magnetic field is set up by two stationary solenoids which surround the main contact cylinder. The centre of this cylinder is of iron and the return circuit is formed by a metal backing to plate carrying



S I B, Soft iron backing; C, Contacts; S, Solenoid.

Fig. 7.—Oerlikon Magnet Blow-Out Controller.

the vulcabeston partitions. The arrangement is said to be very effective, and, as will be seen from fig. 7, it takes up very little space.

Car Lighting Switch and Fuse.—The General Electric Company, of America, make a very neat car lighting switch and fuse in which is incorporated the magnetic blow-out idea. The arrangement is shown

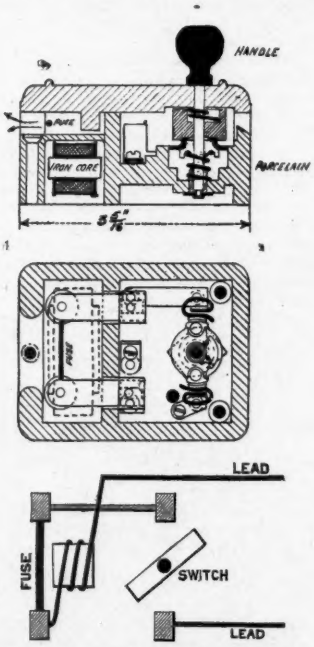
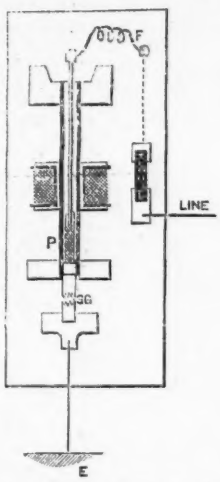


Fig. 7A.—Car Switch and Fuse, with Magnetic Blow-Out.

in fig. 7A, and it will be noticed that there is a small electro-magnet immediately below the fuse wire. Although only $\frac{3}{4}$-inch is allowed between the terminals, yet this is found sufficient for a 500-volt car circuit when the blow-out device is used.

Combined Solenoid Blow-out and Fuse.—A clever combination of the solenoid blow-out and fuse has recently been devised. It consists of a fuse wire carried round a porcelain block many times and attached to terminals at either end. The fuse wire itself thus forms a solenoid, and when a heavy current passes the magnetic field given by the spiral is sufficient to deaden the arcing, the direction of the magnetic field being such that what arcing does occur is driven outwards from the centre support.

Circuit Breaker and Shunted Fuse.—Circuit breakers which have been so uniformly successful for voltages of 500 or so, failed with several thousand volts even when the break was increased to several feet. This fact and the inconvenience of operating very large switches, therefore necessitated some special method of using this



F, Flexible; P, Plunger; S G, Spark gap; E, Earth.

Fig. 8.—Garton-Daniels Lightning Arrester.

valuable appliance for high tension work. This was found in the addition of a thermal device in the form of a shunted fuse, as first suggested by Mr. Mordey in 1888. The circuit breaker contacts are arranged to give a comparatively short opening, and when the breaker is opened by the usual magnetic device, current is thrown on to the fuse, which being enormously overloaded goes off with violence, sufficient time having, however, elapsed to enable the circuit breaker contacts to get a fair distance apart.

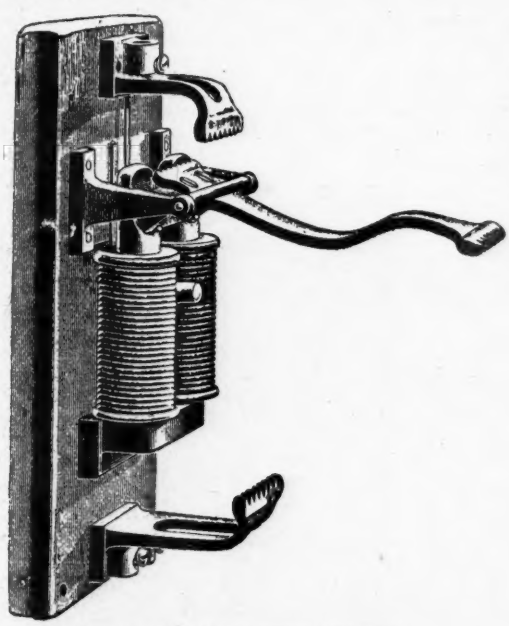


Fig. 9.—Wood's Lightning Arrester.

It is interesting to note that one of the principal arguments with those advocating circuit breakers has always been that the employment of circuit breaker saved the cost of fuse renewals, and also the time necessary to get a new fuse into place. The addition of the shunted fuse nullifies these points, and it is a question therefore whether it would not be cheaper and better to employ a fuse only.

The writer does not propose to describe lightning arresters * in

* The name lightning arrester is a misnomer, as its purpose is to give the lightning the shortest possible path to earth. Its *arresting* properties are only necessary for stopping the arc which follows after the lightning flash, and which arc is apt to be kept up by the machinery working on the circuit.

detail, but there are forms in use which are so nearly akin to circuit breakers, that it may be interesting to briefly refer to them.

The Garton-Daniels Arrester is shown in fig. 8. The lightning discharge enters at the lower end of the graphite resistance (shaded black), and from there passes through the flexible cable to a soft iron plunger, which normally rests on the top of the upper discharger. It then jumps the spark gap and goes to earth, but if current follows, the drop across the graphite resistance, with which the solenoid is in shunt, sends current through the solenoid, and the resulting magnetism draws up the soft iron plunger several inches, thus breaking the arc inside the tube.

Wood Arrester.—The wood arrester, as made by the Fort Wayne Corporation, also depends on a mechanical movement to break the arc. Fig. 9 shows the device. Both line and machine terminals are connected to the lower part of the arrester. Earth is connected at the top, and the lever thus forms the path for the lightning discharge, there being a spark gap at either end. In its normal position the lever is vertical, but when a discharge occurs the dynamo current

Fig. 10.—Sentinel Automotor Circuit-Breaker.

momentarily following the discharge energises the coils, thus drawing the plungers, and tilting the lever into the position shown in the figure. Directly the arc is broken, the coils lose their magnetism, and the lever falls by gravity into its normal position again, ready for the next discharge.

The Brush Electrical Engineering Company supply a somewhat similar apparatus.

Sentinel Circuit Breaker.—An interesting if somewhat complicated automatic circuit breaker is made by the Sentinel Electric Company, of Wilmington, Delaware, U.S.A. The arrangement is indicated in fig. 10, which shows the triple-pole type. A bar of brittle metal

Fig. 11.—Sentinel Circuit Breaker Switch.

is mechanically broken out by a spring released by a trigger, this latter being actuated magnetically as in the I.T.E. and other circuit breakers.

Unlike a fuse which first melts at the centre and gradually burns away towards the terminals, the piece of metal in this case is removed mechanically in its entirety, and there is thus exceedingly little arcing. There are no moving electrical contacts, the apparatus is not affected by electrolytic action and does not become jammed, which is sometimes the case with the ordinary circuit breaker.

Fig. 11 shows the idea applied to a switch, E and K being the pieces of metal placed ready for breaking out.

(To be continued.)

INSTITUTION OF MECHANICAL ENGINEERS.

Contrary to ordinary practice, a non-technical man has given an address before the Institution of Mechanical Engineers in the person of Lord Charles Beresford, who had much to say on China as a field for mechanical engineers. Some of our contemporaries appear to have taken his remarks as illustrating a phase of Chinese character very different from that of the European. We fail, ourselves, to see very much point in this. For example, the speaker saw a big gun which had been loaded with the wrong powder, and the breech had blown out and killed some men. Untaught by this experience they tried the same powder in another gun, and more men were killed. This is looked on as carelessness of life. In what is this different from the English? We ourselves, mere outsiders, had information that the British Army was short of guns. It was notorious in the Army itself. The Government must have known of it. Yet nothing was done to make good the deficiency, and the Government were forced into war without guns or cavalry, and only by borrowing from the Navy, and risking to such extent our first line of defence, have we been able to make the stand we have made at Ladysmith. Has not our Government been far more careless of life than the derided Chinese Government? So while the Chinese trained guns in a way to both hit the enemy and kill their own men, our English Government, for lack of proper appliances, are killing our own men, even if they are hitting the enemy.

Paraphrasing the old adage, "What is the use of temptation unless you fall into it?" British generals seem to carry out their masterly strategy by asking themselves, "What is the use of an ambush unless we fall into it?"

Again, it was found difficult to persuade the Chinese that China was not being robbed when the foreigner was allowed to make investments in the country. Is not this exactly the attitude of the protectionists and tariff mongers of America and most European nations, too, though to a less extent? And is not the same spirit equally rampant in this country, though only in the matter of local politics, for in Imperial politics we seem to have left the rest of the world behind us a very long way. Lord Charles gave an instance also of the weak and foolish policy pursued by the British Government, who when some of Mr. Kinder's engineers were maltreated by rioters—Mr. Kinder being the engineer of a 300 miles railway—simply called a conference of the whole of the foreign ministers, by whose united action the rioters were whipped, just as were some other men who had damaged a pump handle. Lord Charles aptly terms this skulking behind foreigners, many of whom doubtless were not sorry to see British subjects maltreated. What would Palmerston have done? It was safe in his days for an Englishman to go anywhere. China is likely to be a large factor in the near future. The coal fields of Shansi have seams 80 feet thick, and generally the mineral wealth of China is incalculable. Manchuria is a white man's country climatically, resembling Vancouver, B.C., in soil and in resources. With such immense resources and so enormous a population the time will come when China must be a power in the world. At one time the Japanese were quite as averse as the Chinese are now to any outside influences. Indeed, we believe the Japanese were even more persistently hostile than the Chinese. But Japan woke up, and to-day one European power—Russia—is sorry that she did so. China has 300 or 400 millions of inhabitants. This number of people cannot be exterminated. They live in a fruitful country, and some day they will become the equivalent in power to 10 or 15 Japans, and probably all the world will be sorry that they were wakened up, and only the United States will be powerful enough and numerous enough to withstand them. Lord Charles, though he does not look so far forward, sees the potentiality of the Chinese Empire, and entertains hopes that, in conjunction with America, Japan, and Germany, we may preserve the open door. He does not mention other countries, for their trade is practically *nil*; Russia, for example, only sending two cargoes of seaweed to Manchuria during last year. Undoubtedly China will be a huge consuming nation when wakened up to the desire to live differently, and made capable, by the development of its wealth, of becoming an outside buyer.

THE STEAM ENGINE FOR ELECTRIC TRACTION POWER HOUSES.

In no department of high-class power generation is economy so much sacrificed as in traction work, if measured by the weight of coal burned per Kw. Writing on the subject in the *Engineering Magazine*, Mr. C. A. Hague calls attention to the growing size of power units which already bid fair to become as large as 10,000 H.P. in a single unit. Seven or eight years ago direct connection was little known—no doubt he is referring to traction work, not to English electric light practice—instead there were belts and clutches and countershafts, and few plants with five or six units of 1,000 or 1,500 H.P. To-day three-phase alternating plant might be carried up to the 10,000 H.P. limit. When steam roads come to be electrically operated, the variable load due to the passengers will be a much less proportion of the fixed load than is the case with street car work.

In selecting engines for traction work the great load variation is an important factor, and that engine must be chosen which gives the best commercial economy. With steam engines higher types of engine in respect of multiple expansion demand the closer adherence to the most suitable conditions. With a plain slide valve engine a

wide variation with throttling governor will cause quite a comparatively small effect upon economy, but as the organism of the engine is raised in complexity, so will departure from ideal conditions reduce the economy. This has so far put a check on any serious development beyond that of the compound engine.

Comparing traction with other work, the author gives the following figures for different types of engine under steady load and the ordinary load of a power house, the figures showing relative steam consumptions:—

Type of engine.	Steady load.	Power house.
Simple non-condensing	100	130
Simple condensing	100	145
Cross-compound condensing ...	100	125
Triple-condensing	100	150

The cross-compound engine hardly bears out the initial statements, but it is just for this reason that this type of engine has been so much used, for it is well suited to its work, especially if fitted with variable expansion gear on each cylinder. The compound engine is, in fact, fairly free from complication, and is a fair compromise of power load and temperatures. Variable load is held to be the obstacle to multiple expansion; the author looks to using as many as eight cylinders on a quarter-crank engine to produce 15,000 H.P. in a single unit, but he would still retain the compound engine. The trouble with a load varying from zero to 50 per cent. overload is, he thinks, less a matter of the total range of expansion than of the use of steam in so many cylinders in series. He suggests that engines should be governed directly by their voltage rather than by speed. Let the speed take care of itself and look after the voltage, is what he suggests. Why, also, should we be so saddled with the old idea of producing pretty indicator cards?

In his own experience he has found it useful to apply automatic expansion to the first two cylinders of a triple expansion engine, and fix the third cylinder cut-off well out, as many engineers now do in two-cylinder compounds, fixing the L.P. cut-off at seven-sixteenths of the stroke. His idea, evidently, is to use the clearance volumes throughout the engine as a means of keeping back steam from the large final cylinder, and of letting it out freely to this cylinder as and when the power demanded decreases or increases. English tramway practice, so far, has been along rather difficult lines. Taking any one power station as an example it will generally be found serving one long line of communication. If the output of such a station be compared with that of a station serving several routes the difference observable will be found to be very great. In the one case the variation is rapid and wide. In the other case the output as shown by the feeder panel ammeters will be of the same unsteadiness as the station ammeter in the former case, but the station ammeter in the latter case will be found steady, its movements being the mean only of the movements of the various line ammeters, which balance one another for long periods of time at a stretch. This is, of course, only what might be expected, and the more varied and numerous the branch lines the steadier will be the station load. Experience alone can show what the anticipated mean load of a station may be taken to be, but it will certainly not vary under usual circumstances with such enormous rapidity and frequency as has too frequently been claimed. We are promised a review of the forms of engine adopted in large installations of typical form both as to general arrangement and constructive features.

BRITISH AND AMERICAN MACHINE TOOLS.

An article in the *Engineer* endeavours to draw comparisons on this vexed subject. Attention is specially directed to the American practice of confining a works to the manufacture of one, or at most, a very few machines. Unlike our own shops, the American shops do not make lathes and planers under one roof, and even the man who makes lathes will confine his energies to one class of lathe, or even to one size of that class. In this way, of course, men become expert, if narrow, and the writer considers that the convenience of working tools is well thought out. In many cases, too, he does not think that the reproach of lightness can be held against American tools, for they actually weigh more than English tools so recently denounced by Americans as clumsily heavy. But American tools are still, in many cases, light. With lathes, for example, of the same size, the American head stock gearing is not above two-thirds as wide as in English practice, and the American slide rest is very paltry. An English user of American machines recently informed us that he found American machine tools were good so far as the machine work was concerned, but that they were most unsatisfactory in all points where hand work came in, as, for example, the fixing and alignment of brackets, &c., all which is what we should expect, the Americans being *par excellence* machinists rather than handicraftsmen.

We need hardly again refer to the great difference of conditions here and in America, more particularly in the matter of materials, on the softness and tenderness of which under the tool the Americans pride themselves more, we believe, because Americans are so wrapped up in the idea of rapid manufacture rather than of the durability of the thing manufactured. Evidence is accumulating every day of the fact that this idea is carried to an unwise extent by American manufacturers.

The writer of the article is particularly struck with the large use of vertical boring and turning mills, which have superseded the large lathe, and are a source of economy in many ways. Thus the overhead traveller can dump down the work on the table of a vertical tool and go off on other work, whereas it must remain in attendance on an ordinary lathe until the work is fixed.

We think the author is possibly a little out of date in his knowledge of English shops, for he rather exaggerates the neglect of tool-grinding machines, and he states that special tool grinders are not to be obtained from any English makers. As one of our American contemporaries recently pointed out, the very best American works have been compared with the tail end of our own shops, to the obvious disadvantage of the latter. While there is a good deal of truth in the arguments advanced, there is a great deal of exaggeration, for our best English workshops do not get into print, and, as a fact, do not, to say the very least, compare badly with the best American shops. It was from one such shop, large users of both English and American tools, that we learned that though the American tools were so good as regards the machine work upon them they were so poor in adjustments. In all cases of American machine tools they had found it necessary to readjust everything, and they had also found that their production as worked on English methods was greater than American rates, and Americans would not even credit the fact.

PHYSICAL SOCIETY.

At the meeting held on December 8th, Prof. W. E. Dalby exhibited a friction dynamometer. The torque to be measured produces a twist in a spiral spring, and the object is to determine the amount of this twist. Side by side upon the shaft are two pulleys, one keyed to the shaft and the other fastened to the end of the spring. The lead of one pulley upon the other, therefore, measures the twist. Two other pulleys are mounted upon a slide and are joined up to the first ones by means of a continuous band similar to a Weston's differential pulley block. When the shaft is at rest the two pulleys on the slide are touching, but any motion of the shaft produces a twist in the spring, and, therefore, a lead of one of the shaft pulleys on the other. This produces a separation of the slide pulleys, which is proportional to the lead and therefore to the torque, and so from a knowledge of the constants of the dynamometer and its number of revolutions per second the power transmitted is at once determined.

SMOKE.

There are three distinct forms of smoke turned out of chimneys, using the term smoke as indicative of imperfect combustion, although in one case there is no colour of which to complain.

The first class of smoke is that which consists of numerous particles of soot carried in otherwise transparent furnace gases. The second class is not, strictly speaking, smoke, but consists of impure hydrocarbon gases distilled from coal freshly thrown upon the fire. Its colour is a dirty green or yellow. The third class of smoke is that colourless product of imperfect combustion known as carbon monoxide.

Before any attempt can be made to prevent smoke, its formation must be studied. We will deal first with the second class, the green and impure gas driven off bituminous coal when placed upon the fire. This kind of smoke consists of the hydrocarbons of the coal, the ethylenes, batylenes, methanes, and other heat and light producers of coal gas mixed with tars and water and ammoniacal products. The ordinary house fire is a producer of this kind of smoke, because it is usual to feed fresh fuel upon house fires from above, and in comparatively large quantities at once. The evolution of gas from a solid must of necessity cause an enormous absorption of latent heat, and such gases are cold, and will usually not ignite by application of a lighted match. As the under bed of the fire acquires heat the gases are liberated at a higher temperature, and when an opening is made through the upper coal, admitting air through or over the glowing fuel, the green gases will ignite, first in little bursts of flame and later in continuous flames of considerable length. To prevent formation of green smoke the fresh fuel thrown upon a fire might be applied continuously. One way of doing this is to have a deep hopper below the fire with a movable bottom which can be raised by a rack and pinion gear, the top of the fire being thus maintained at or near the same level, and the evolution of gas being continuous and steady and not so great as to overtax the temperature maintaining capacity of the incandescent mass of superincumbent fuel. When continuous top feeding is practised —a practical impossibility in most houses—the coal is constantly dribbling upon a flaming fire, and there is sufficient temperature and sufficient air to maintain continuous flaming combustion. But the fire is contained between three walls of firebrick and no boundary is water cooled. The ordinary house conditions are, however, as above stated, alternate periods of heavy firing and rapid gas evolution with insufficient temperature.

The third class of smoke is not possible, we should imagine, in a house fire. Carbon monoxide gas is formed whenever air is passed through a thick mass of incandescent coke. When a large household fire has become bright and red throughout this gas comes off at the surface of the fire, but as the surface is freely exposed to the draught of air that is moving towards the chimney it rapidly unites with the fresh air and burns with the characteristic purple flame of monoxide upon the surface of the fuel. Carbon monoxide is formed in closed coke stoves, and has the property of passing through red-hot cast-

iron. It is possibly due to this property, combined with its remarkable affinity for the hæmoglobin of the blood, that people who use such stoves become pale and anæmic.

When we come to apply observations made upon a house fire to the larger furnace of a steam boiler, we shall discover that the conditions very closely parallel themselves, and results must be sought along similar lines. The green smoke from fresh fuel is the cause of the worst ingredients of a yellow fog, which can be closely paralleled by closing the chimney of a house fire when freshly coaled. In a boiler furnace, heavily fired, these impure hydrocarbons are given off, and find themselves surrounded—below by the cold fresh charge of coal, and above by the water-cooled furnace. They have no source whence to gain an accession of temperature, and they escape at the chimney top unburned, and absolutely wasted. Very occasionally it will happen that a volume of such gas gets as far as the main flue, and acquires temperature from the hot brickwork, and being mixed with the correct proportion of air, a flue explosion takes place, sometimes of considerable severity. Ordinarily, with care in stoking, or by the mere accident that the process of stoking is not instantaneous, the evolved gases ignite with the first shovelful, and the fresh fuel not smothering the fire beneath, flame is continued, and more or less combustion takes place. But hydrogen unites with oxygen more easily than does carbon, and it usually happens that the hydrogen burns, and the nascent carbon is set free unconsumed as soot, and forms black or grey smoke. The reason for this smoke is, that there has been an admixture of air either insufficient in quantity or improperly intermixed, or the temperature has been too low for perfect combustion, the surroundings of the furnace, *i.e.*, the water-cooled plate, exercising a chilling effect.

It has been found by experience that, with careful stoking, a Lancashire boiler can be fired smokelessly without loss. The conditions necessary are a velocity of draught of 30 feet per second, which is not excessive; an intimate admixture of the gases driven off the fire with fresh air admitted in fine streams above the fire; a temperature sufficient to ignite the mixed gases at the bridge when they have all swept over the length of the fire and become well mingled, and a free space in which combustion can complete itself. The first condition of draught velocity is easy to obtain. It represents a fair draught only. The second is obtained by an air opening in the furnace door of about 1½ inches per square foot of grate, and a perforated inner plate. The fourth condition can be provided structurally, but the third is the critical condition, which is sometimes obtained and often not secured. It is obtained by the better stokers who do not make smoke, and it can be obtained in furnaces wholly or partially lined with firebrick. Because these conditions have not been understood by them, too many engineers have gone to the length of saying that bituminous fuel is of necessity smoke producing. We have long pointed out that the common form of water-tube boiler, from the fire surface of which all the gases rise directly between cold tubes without the mixing action necessary or the space for combustion, must inevitably be a smoke producer. In the furnace proposed by Mr. Crompton the refractory furnace lining is provided, but Mr. Crompton has, apparently without recognising the effect, also provided the almost equally important point, viz., the sweeping action over the length of the fire of the products of combustion and freshly admitted air.

Mr. Crompton appears to object to our expression as to the *tardy* recognition of bituminous fuels and means of using them, but we really cannot see why he should object, for he is quite a recent convert himself, and has for many years had access probably to the Reports on the Wigan Coal Trials often referred to in our columns, and his furnace, as illustrated, is nothing more nor less than what we have often advocated—not originally, by any means, as an ill-natured critic has professed to believe we claim. Messrs. Adams & Co., of the Ant and Bee works, at West Gorton, over 15 years ago used an entirely external brick furnace to a multitubular boiler, and we believe they could not make smoke when they tried to do so. There is, therefore, nothing new in Mr. Crompton's discovery, but merely, as we said, a tardy recognition of old practice. Unfortunately, the craze of the modern engineer for crowding the maximum possible amount of machinery into the minimum of space is responsible for the difficulty of doing very much to established boilers in the way of external additions.

The difficulty with all forms of revolving grate is obviously that the back of the grate is too thinly covered with fuel, and admits far too much air. It might be possible to place a deadplate below and close up to the underside of such grates in order to cut down the volume of air having access to the grate under its less thickly covered area. This does not appear insurmountable, though we are not aware of its having been attempted. Certain it is that combustion is a purely chemical process, only to be carried out above a certain minimum of temperature, and smoke is evidence of improper conditions. But the dictum that smoke is inevitable is not true, except so far as it is due to the use of unsuitable apparatus.

We might add that a common error in practice is the entire use of flue dampers for regulating combustion. The flue damper not merely checks the draught below the grate, but above it also; it checks the flow of air when the door-grids are open, and deprives the gases from green fuel of the necessary excess of air.

The flue dampers ought to be nearly wide open, and combustion should be regulated by dampers at the ashpit to shut off the air from beneath the bars. In this way no check is placed on the admission of air at the doors. Of necessity the door-grids should close soon after the fresh charge has been fired. Assuming each ton of coal to yield 10,000 cubic feet of gas, the average charge of ½ cwt. of coal in a Lancashire boiler demands air sufficient to burn 500 cubic feet of gas. If three minutes are required to drive off this volume, we may assume that 150 feet come off the first minute, 200 feet the second minute, and the remainder during the third minute, after which the air admission totally ceases.

Automatic air admission by means of louvres in the furnace door should thus commence with louvres above the horizontal position; they gradually open to the full, being then horizontal, and slowly close. In the continuous firing of a machine stoker the gases are not thus intermittently evolved, and it ought to be much easier to prevent smoke than with hand firing. An inspection of a mechanically-fired furnace generally reveals too red a flame, indicative of insufficient temperature and pointing to the need of a refractory lining. No success will ever be permanent and economical until temperature conditions receive better recognition.

THE NORTHAMPTON INSTITUTE CONVERSAZIONE.

On Friday evening last Sir Henry Roscoe, LL.D., F.R.S., presented the certificates and prizes awarded to students during the 1898-99 session. The list of awards is made up mainly of those who have made successful passes in telegraph and telephone subjects, while there were also numerous awards given to Post Office telegraphists and others for successes in magnetism and electricity, mathematics, electrical and mechanical engineering, applied physics, &c.

Dr. Mullineux Walmsley, principal of the Institute, in reviewing the work of the session, said the number of enrolled students and members had increased 53 per cent. on the preceding session, and the educational work showed remarkable development. In outside examination successes the Institute had secured from the City and Guilds Institute 383 passes and eight medals, and from the South Kensington examinations for Post Office telegraphists 368 passes. Among the developments of the year the greatest was the transfer of the Telegraphists' School of Science from the General Post Office to the Institute.

Sir Henry Roscoe delivered an address on secondary and technical education. He argued against the appointment of a newly-established body for the administration of these branches of education which he declared to be inseparably connected. It was not advisable to increase the number of local educational authorities by a new and untried body. They ought rather to keep to lines already established and develop the system which had worked well. In relation to the Northampton Institute, there was one point upon which he had a word to say. Especially in Clerkenwell, a knowledge of the principles and practice of electrochemistry was of great importance, and the principal had drawn up an interesting report on the advisability of setting up in the Institution a new department, new in the metropolis, and even in the country. He cordially agreed with the proposal, but warned all concerned that this was a difficult subject.

For the edification of the many thousands of students and their friends who were present, there was an elaborate programme of arrangements prepared, both for amusement and instruction. Sir H. Roscoe's address seems to have received little attention from the visitors. Perhaps not unnaturally, the greater crowd was to be found witnessing exciting polo matches, Balaclava melées, &c., by the Swimming Club, or gymnastic displays in the gymnasium, listening to Madame Sophie Davies' Mandoline Band in the Hall, or whiling away the time in some such innocent way. It seems almost a pity that gymnastic and swimming displays, each of which took some hundreds of the audience, were being held simultaneously with Sir Henry's part of the arrangements. Notwithstanding the many attractions, however, quite a respectable party put in an appearance at Dr. Mullineux Walmsley's half-hour lecturette on "Alternating Currents." The lecturer endeavoured in popular language to explain the difference between continuous and alternating currents, and made some remarks as to their measurement, &c. He proceeded to describe the Duddell oscillograph, which would have interested his audience considerably more if the pre-arranged experiments had only "come off," but neither at the bidding of the Doctor's assistants or the inventor himself could any satisfactory results be obtained. It was explained that the motor was responsible for the failure of the experiments which were to have been made with this "tricky" apparatus, as the lecturer termed it. Dr. Walmsley said nice things about Mr. Duddell, and this drew from the audience a well-deserved round of applause which signified appreciation, and as usual on such occasions, sympathy. The lecturer, in the presence of the inventor, genially disclaimed all responsibility for the failure. The audience therefore dispersed with the promise that at intervals during the evening demonstrations would be given "if" the motor could be moved from its obstinate determination not to work.

At a later hour Mr. A. W. Martin delivered a lecturette on "High Speed Telegraphy." The other special demonstrations included the liquefaction of air, mortising by machinery, colour photography, &c. In all of the laboratories and workshops there was great activity, and this remark applies particularly to the electrical engineering laboratories and the exhibits of electrical instruments, the mechanical laboratory with its automatic machine tools, the engine room with its steam turbine and lighting apparatus.

Electric motors were employed upon a dozen or so occupations in the several departments. There was a collection of Postal Telegraph apparatus, and to mention briefly a few other things which were prepared:—Parsons' steam turbine exhibit, X rays, and Tesla apparatus, electric brazing, electric wiring, technical chemistry, and last, but not least, an Armstrong quick firing gun (12-pounder), which perhaps excited as much attention as anything, save the swimming contests, and proved that even within the dry walls of a technical institute the war spirit runs high.

Altogether, we cannot help saying a good word for those who have so assiduously worked upon, and so successfully carried through, a very elaborate programme. They must have been well rewarded by the interest and enjoyment with which the great multitude of visitors gave evidence of their appreciation.

REVIEWS.

Practical Magnetism and Electricity. By J. R. Ashworth, M.Sc. Second Edition. London: Whittaker & Co. 1899.

This truly practical laboratory manual has been revised and corrected; we need only say that the very favourable opinion which we formed of the book on its first appearance remains unchanged. The instructions to students are excellent, while the hints intended for teachers are of a helpful character. We may take exception to the author's modest remark that "the whole book is, of course, to be treated as supplementary to the theoretical teaching of the class room and class book;" on the contrary, we are most strongly of opinion that the theoretical teaching ought to be regarded as subordinate to the practical lessons of the laboratory, which *stick*—lectures don't.

The Principles and Practice of the Valuation of Gas, Electricity, and Waterworks for Assessment. By Thomas Newbigging, M.I.C.E., and William Newbigging, A.M.I.C.E. Second edition, 8vo., pp. 104. London: Walter King, 11, Bolt Court, Fleet Street. Price 5s.

This handy little volume is a reprint of certain articles which were published in the *Journal of Gas Lighting*. "Owing to numerous requests," the authors have dealt with the rating of water and electricity works, the previous edition having been confined to the valuation of gasworks.

In their laudable endeavour to deal with this somewhat dry and difficult subject in a popular manner, the authors may be said to have met with success. After adverting to the history of rating, and to the robbery to which gasworks and other undertakings of a public nature are exposed at the hands of the rating authorities, the authors proceed to explain, by reference to typical examples, the general principles upon which gasworks are rated for assessment. In the space of about two pages (see p. 12) a very succinct explanation is given of the method by which the *ratable value* is arrived at, and a little later on the authors explain the principle of rating upon the basis of percentage, concluding their observations at page 17 by saying that "It is clear that to take a percentage usually reckoned on ordinary property would not always represent the fair rent of a gasworks, and therefore an assessment based upon such an ascertained gross rental value would not, in many instances, bear equitable assessment."

We have no reason to criticise the arrangement of the work as it stands, except to say that more careful sub-division of the matters dealt with would render it more easy for the man of business to find his way about in its pages. Although the index is good, it is more convenient to have the different subjects dealt with in separate chapters.

The good wine, so far as electrical engineers are concerned, is reserved to the end of the work, where the rating of electric supply works is dealt with. In dealing with this portion of their work, the authors were troubled with the usual difficulty, namely, lack of authority. No case appears to have arisen with regard to the rating of electric works of any kind; but it is important to observe that the rules applicable to gasworks can, in a large measure, be used when the assessment committee have to determine the liability of an electrical company. An important question arises with reference to electric supply companies, with which the gas companies are not troubled. The compulsory purchase of the undertaking by the local authority under the provisions of the Electric Lighting Act, 1888, naturally diminishes the prospective value of the works. Can this be taken into consideration in estimating the value for rating purposes? The authors say "this is a point which should have consideration," and a reference to the case of the London Street Tramways Company *v.* the London County Council (1894) 1 Q.B., 489, will show that although not expressly decided for the purpose of the Electric Lighting Act, the expression "value" has been subjected to the scrutiny of the Court in connection with the Tramways Clauses Acts, 1870. The result of that decision was that the value of materials is their value without reference to the past, present, or future profits derived or to be derived from the undertaking. Mr. Edward Boyle in his "Law of Rating," p. 510, also appears to be of opinion that the risk of being "taken over" is not one which should be allowed to lessen the value of the undertaking.

Not the least important part of the work is the digest of cases which may be found at the end. With regard to the case of Southwark and Vauxhall Water Company *v.* Hampton Urban District Council, (1899) 1 Q.B., 173, we understand that an appeal is pending to the House of Lords. The book can be recommended to those who wish to obtain some idea of the principles of rating.

THE UTILISATION OF BLAST FURNACE GASES IN THE GENERATION OF ELECTRICITY.

Preliminary Considerations.—In considering the applicability of blast furnace gas for the development of power for the generation of electricity, it will be necessary to make some investigation into the thermal and chemical qualities of the gas, and also its physical properties.

The operation of smelting iron consists of charging into a suitable furnace a mixture of iron ore, fuel, and flux, and applying air blast to bring about the necessary combustion of the fuel, so as to supply the reducing environment and the high temperature required to melt the reduced iron and the slag formed by the combination of the flux with the earthy matter of the ore and fuel.

The furnace in which iron is smelted consists of a cylindrical shaft from about 45 feet up to 80 feet or 90 feet in height; the older furnaces being from 45 feet to 50 feet in height, while those of more modern construction are increased up to from 80 to 90 feet high.

The process of smelting iron is carried on continuously during the life of the furnace, which has been known to extend to considerably over 100 years, if circumstances will permit, and the stack is at all times full of material almost up to the top.

Iron ore consists of iron in combination with oxygen, associated with more or less earthy matter. In the smelting operation the oxygen is removed from its combination with the iron chiefly by the action of carbonic oxide gas, leaving the iron in the metallic state, while, through the influence of the high temperature, the earthy matter of the ore, as well as that which constitutes the ash of the coke, combines with the flux and forms a liquid slag. Whatever class of fuel is employed, the essential constituent is carbon.

Briefly stated, the chemical action occurring in the blast furnace is as follows:—

Air blast entering near the bottom of the furnace comes in contact with highly heated carbon, and forms carbonic acid gas, at the same time generating an intense temperature; then the carbonic acid gas is almost immediately converted into carbonic oxide gas through coming into contact with more carbon. The iron ore parts with its oxygen to a certain portion of the carbonic oxide, changing it back to carbonic acid, but this reaction can only occur in the presence of an excess of the latter gas, so that there passes off from the top of the materials in the furnace gas consisting of nitrogen from air, carbonic acid, carbonic oxide, and small percentages of hydrogen, marsh gas, &c.

Having so far shown that a certain proportion of the gas evolved from a blast furnace is combustible, a little further consideration will show that this proportion cannot vary through any large range, owing to the depth of the materials in the furnace, the regularity of the mixture of the materials, and of the charging of the same, and the continuous production of large volumes of gas.

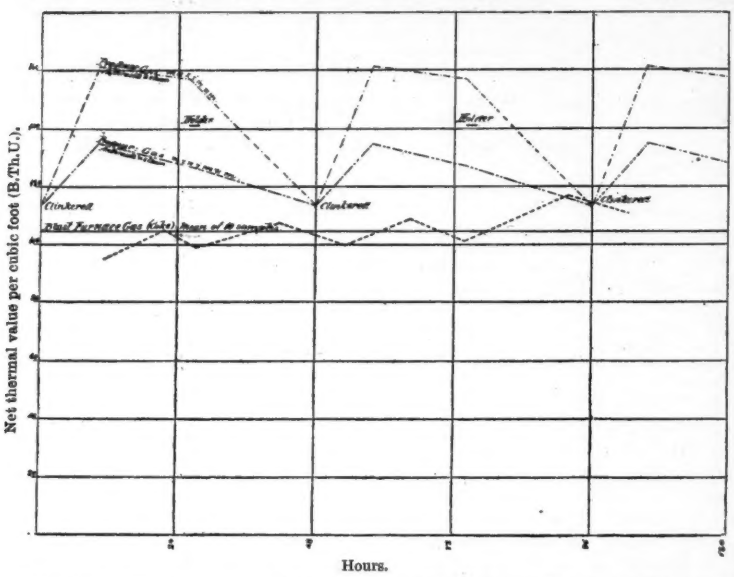
Whether the furnace be only 45 feet, or as much as 90 feet in height, the evolved gases have a high temperature, ranging from about 250° F. to over 1,000° F.

Besides being at a high temperature, the gases also carry, in mechanical suspension, a considerable quantity of dust and fume.

The Evolution of Attempts to Economise the Gas.—Prior to the utilisation of the so-called waste gases for the produc-

tion of steam and heating of the air blast, the mouth of the furnace was not closed in any way, but the gas was allowed to escape in a burning state into the atmosphere.

Then followed methods by which a considerable portion of the gas was drawn off by chimney draught, and used in place of coal for heating stoves and raising steam in boilers, by means of tubes connecting with chambers near the top of the furnace, or a tube projecting down centrally some distance into the furnace, allowing the fuel, ore, &c., to be charged round the tube. These methods, though not recovering all the gas, have the advantage of permitting the materials to be freed from moisture without its passing into the gas, and are still retained in many of the old furnaces.



Comparative Diagram, showing the Variation in Thermal Value of Producer Gas and Blast Furnace Gas.

The most general method now employed for the recovery of the gases is the cup and cone, or bell and hopper device.

By this arrangement the top of the furnace is closed, except at such times as the cup or bell is lowered to admit the charge. The gas is conveyed through tubes from the top of the furnace to the boilers and stoves.

The Fuel Used in Blast Furnaces.—The fuel used for smelting iron is charcoal, splint coal, coke, and in some few cases anthracite.

Whatever the fuel used, the essential constituent is the fixed carbon, and the value of fuel for the smelting of iron depends upon the proportion of this constituent, as well as the weight of fuel required to produce unit weight of pig iron.

In general modern practice coke is the principal fuel, though in some furnaces splint coal is employed, and in others anthracite, or anthracite and coke mixed.

Typical Analyses of Blast Furnace Gas.
Percentage by Volume.

—	Charcoal.	Splint coal.	Coke.		Coke 4. Coal 1.
Carbonic acid...	11·22	6 58	8 78	4 7	4·80
Carbonic oxide	24·20	26·09	29 93	35 0	34·62
Hydrogen ...	4 11	4·56	1·61	1 8	3 63
Marsh gas ..	2 14	2 29	...	1 5	...
Nitrogen ...	58·33	60 48	59 68	57 0	56·95
	100 00	100·00	100 00	100·0	100·00
Thermal value per cubic foot measured at 60° F. Products of combustion, 217° F.	108 BThU	117 BThU	100 BThU	130 BThU	120 BThU

In a furnace using a certain class of fuel, ore and flux, the composition of the waste gases varies only slightly during the working of the furnace, and only a few analyses of the gas are required to fix the average composition and thermal value. Moreover, with the same fuel, the product of the blast furnace may be spiegeleisen, basic pig, or foundry iron, each requiring very different weights of fuel per ton of product without having any very considerable effect upon the composition of the gases.

The volume of gas given off varies with the class of fuel and its constitution, thus splint coal gives about 130,000 cubic feet of gas, measured at 60° F., per ton of coal. Coke averages about 170,000 cubic feet per ton charged. Mixtures of coke and coal will, of course, give a quantity in proportion.

British blast furnaces produce, on the average, about 23,000 tons per annum each, and if we allow an average of 1 ton of coke to produce 1 ton of pig iron, each furnace consumes 23,000 tons of coke each year, which is equivalent to 2·625 tons per hour, and 446,250 cubic feet of gas will be given off in that time.

The Extremely Dirty Character of the Effluent Gas.—Blast furnace gas has, however, one very important disadvantage, owing to the fact that it always carries along with it a considerable amount of dust and fume. The quantity and composition of this dust is very variable, obviously depending upon the materials charged into the furnace.

It is found that when making ferro-manganese, spiegeleisen and basic pig-iron, the quantity of dust very much exceeds that resulting from the production of Bessemer pig and foundry iron.

Mr. A. S. Keith, of Middlesborough, has stated that the quantity of dust per week from a furnace, making from 600 to 700 tons per week (Cleveland ore), amounted to from 2 to 5 tons per week, though in another case only about 1 ton per week of dust was obtained. However, in all cases, a large portion of the dust is in a very fine state of division, and while the heavier part is deposited all along the tubes and flues, and in the boiler furnaces and flues, there is still a large amount of suspended matter, which is so light, that it is even carried out of the top of the high chimneys usual where the gases are used for raising steam and heating the hot blast stoves.

At Seraing, the flues of gas-fired boilers have to be cleaned every four days.

In a Derbyshire iron works, lately visited by the author, where two blast furnaces were in operation, making together about 460 tons per week, the estimated weight of heavy dust per week amounts to about 2½ tons. This dust accumulates in the flues and tubes, and is removed about every three months.

In the United States there are blast furnaces capable of producing as much as 690 tons in 24 hours, with a fuel consumption (coke) of 15·4 cwt. per ton of iron made. This is equivalent to 22·137 tons of coke consumed per hour, and 3,763,290 cubic feet of gases would be evolved during that period. If the whole of this gas could be employed in gas engines to produce power at the rate of 130 cubic feet of gas per hour to develop one I.H.P., the equivalent power of the gas from such a furnace would amount to a continuous development of 28,948 I.H.P.

It need hardly be pointed out that this enormous power cannot be obtained for many reasons, though the realisation of the value of each cubic foot of gas will, no doubt, bring about a reformation in the views of blast furnace managers with regard to preventing the escape of any of this gas uselessly into the atmosphere.

The Efficiency of the Blast Furnace when Considered as a Gas Producer.

Splint Coal.—

1 lb. splint coal in furnace, 14,091 B.Th.U.

I.—58 cubic feet of gas at 117 net units per cubic foot at 60° F., 6,786 B Th.U.

II.—58 cubic feet of gas at 126·5 net units per cubic foot at 60° F., 7,337 B.Th U.

Efficiency (I) $= \frac{6.786}{14,091} = 48\ \%$. (II.) $= \frac{7,337}{14,091} = 52\ \%$.

Coke.—

1 lb. coke in furnace, 12,960 B.Th.U.

I.—75 cubic feet of gas at 100 net units per cubic foot at 60° F., 7,500 B.Th.U.

II.—75 cubic feet of gas at 130 net units per cubic foot at 60° F., 9,750 B.Th.U.

Efficiency (I.) $= \frac{7,500}{12,960} = 57\ \%$. (II.) $= \frac{9,750}{12,960} = 75\ \%$.

The efficiency of the blast furnace as a power gas generator, as shown by the foregoing figures, is very high, considering that the object of the furnace is to smelt pig iron, and that at one time the so-called waste gases were allowed to pass away into the atmosphere, while even nowadays a very considerable quantity of gas is wasted.

Before going into the question of the utilisation of blast furnace gas, we may summarise its general qualities:—

1. The gas is given off, more or less continuously, in large volumes.
2. The temperature at which it is evolved is *always* high.
3. The gas *always* carries a considerable quantity of heavy and light dust.
4. The hot gas generally contains a considerable quantity of water, in the form of steam, of course, derived from the combined and hygroscopic water of the mixture charged.
5. The thermal value of the gas, though low, is more constant than that of producer gas.

The Utilisation of Blast Furnace Gas.—The gas evolved from the blast furnace is usually conducted away from the top of the furnace by tubes lined with brickwork, and, owing to the large volume passing through the tube and the brick lining, the temperature does not fall much, even when taken to a considerable distance from the furnace. Where, as is very common, the gas is taken directly into brickwork flues underground, the heat is even more completely retained.

This high temperature assists the combustion of the gas when it is applied to heating air stoves and boilers, and, of course, adds to its thermal effect. However, when thus utilised, the gas carries with it, as previously explained, a very considerable quantity of dust, and all apparatus in which it is employed as a heat agent must be so designed that the accumulation of dust, which settles in all places where the gas travels or is burned, can be removed at stated intervals.

The dust and moisture present in the gas cannot be removed without reducing the temperature to about that of the atmosphere, the lower the temperature below 212° F. the drier the gas, but when the gas is thus freed from dust and moisture, and at atmospheric temperature, the heat of combustion in air is so low, that the unprotected hand can be slowly passed through the flame without any inconvenience, and the difficulties of maintaining its combustion in boilers and stoves are very much increased. Even when burning the gas in its hot condition there is frequently great difficulty in keeping up the supply of steam from the boilers, &c.

The Invention of the New System of Power Utilisation.—As the result of experience in blast furnace construction and of very extended research and experiments on the application of various classes of producer gas to internal combustion engines, the metallurgist, Mr. B. H. Thwaite, filed patents in 1894 for the treatment of iron-making blast furnace gas for rendering it available for driving gas engines, or for direct combustion in internal combustion engines. He found that in suitably-designed gas engines, in which a proper amount of compression was arranged, excellent results could be obtained by the explosion of this gas after its treatment by his patented process.

Continental newspapers, including *La Rappel*, gave an account of this innovation—in the last-named in its issue of September 24th, 1895; Thwaite's invention was also referred to in Richard's 1895 edition the *Gas Engine*—as a result, foreign plagiarists are much in advance of British engineers; certain Continental engineers have made experiments in more or less flagrant imitation of Thwaite's invention, and in all cases very satisfactory results have been obtained, although some of the more dishonestly unscrupulous of the imitators are very loth to acknowledge their indebtedness to the British metallurgist. In 1897 designs were submitted by request to important German and Belgian works, of the Thwaite-Gardner system; these have constituted the basis of subsequent work in those countries, and a discreditable advantage has been taken of them.

The pioneer plant in Great Britain, commenced in 1894, and which has been working since, is that at the Wishaw Works of the Glasgow Iron and Steel Company, Limited, providing electric current for arc and incandescent lamps. The blast furnaces at these works use splint coal for fuel, and the gas is previously treated for the recovery of bye products.

Since the conception of the utilisation of blast furnace gas in internal combustion engines by Mr. B. H. Thwaite, and the publication of its practicability, Belgian and German engineers have rapidly made progress with its application, and now they are putting down plants of thousands of horse-power. In this country the more conservative blast furnace owners, engineers, and managers have been slower to avail themselves of this great source of cheap power, but even now its conspicuous economic advantages have been proved, and installations are being projected on extensive scales.

(*To be continued.*)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

23,617. "Turbine dynamo-pneumatic (motive machine)." J. F. M. Riffard. Dated November 27th. (Complete.)

23,631. "Improvements in apparatus for adjusting electro-magnetic ignition in gas or oil engines." E. Bolbrinker. Dated November 27th. (Complete.)

23,663. "Armature for alternating current motors." J. Burke. Dated November 27th. (Complete.)

23,696. "Improvements in and relating to electric alarm systems for the protection of buildings, or for like use." A. G. Brookes. (E. F. Woodman and H. A. Fiske, United States.) Dated November 28th. (Complete.)

23,713. "Improvements in or relating to electrically illuminated advertisements or signs." H. Tripp, G. E. Stephenson, and W. C. Chartz. Dated November 28th. (Complete.)

23,728. "Improved manufacture of lead plates for secondary batteries." M. Wuillot. Dated November 28th. (Complete.)

23,734. "Improvements in or relating to electric lighting or heating apparatus." J. Bouillet. Dated November 28th.

23,737. "Improvements in pneumatically operated contact shoes for third rail electric railway systems." The British Thomson-Houston Company, Limited. (S. H. Libby, United States.) Dated November 28th. (Complete.)

23,738. "Improvements in compounding electric alternators." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 28th. (Complete.)

23,739. "Improvements in electric railway systems and cars." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated November 28th. (Complete.)

23,740. "Improvements in controlling alternating electric current motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 28th. (Complete.)

23,753. "Improvements in maximum electrical current indicators." E. C. Rimington. Dated November 28th.

23,755. "Improvements in electrolytic apparatus." J. D. Darling and C. L. Harrison. Dated November 28th. (Complete.)

23,781. "Improvements in and in relation to trolley heads for electric tramcars." L. B. Powderly. Dated November 29th.

23,813. "Improvements in galvanic batteries." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated November 29th. (Complete.)

23,834. "Improvements in or relating to telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated November 29th.

23,869. "Improvements in incandescent electric lamps." R. B. Ransford (A. W. W. Miller, United States.) Dated November 30th.

23,870. "Improvements in apparatus for electric telegraphy." S. G. Brown. Dated November 30th.

23,877. "Improvements in or relating to electric gas lighters." Henri de Thiersant and H. J. Norballe. Dated November 30th.

23,879. "Improvements in and connected with electric incandescent lamps." F. M. F. Cazin. Dated November 30th.

23,905. "A new or improved alternating current electro-motor." F. M. Lewis. Dated November 30th.

23,918. "Improvements in the manufacture of electrically conductive incandescent filaments and the like." L. de Somzee. Dated November 30th.

23,925. "Improvements in starting regulating and reversing switches for electric motors." J. M. Hewitt and W. G. Rhodes. Dated December 1st.

23,960. "An improved electric switch or governor." E. Cros. Dated December 1st.

24,049. "Improvements in inter-communication telephones." L. E. Wilson. Dated December 2nd.

24,058. "Improved means for carrying off the gases generated in electrolytic apparatus." W. Bein. Dated December 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

26,118. "A conduit and aerial electro locomotor, primarily for laying or drawing in electric mains or other cables for any service." E. L. Benjamin. Dated November 10th, 1897. Relates to an apparatus for traversing tubular or skeleton conduits in the form of three or more rods held in position at intervals by rings. The apparatus is described as being applicable to the haulage of cables or ropes for laying electric conductors, metal rods, or ropes in such conduits; for depositing any objects at predetermined positions in conduits; for drawing through cleaning brushes or scrapers, for sewage, water, gas, and other pipes and conduits; or for cleaning tubular boilers. The apparatus is also applied for overhead or elevated railway systems, whether for goods, parcels, or passengers, or for cash railways. The motive power may be electricity, gas, steam, compressed air, or an endless rope. As described in the specification, the motor is electric, having the field magnet yoke curved in section to correspond with the conduit. The pole-pieces are similarly curved, enclose the armature, which is nilt up of a spider mounted on the shaft, and having three webs. Core discs

are slotted to engage with the webs. These are clamped in position between a shoulder at one end and a screwed-up clamping disc at the other. The armature shaft is shown driving a wheel by means of worm gear, the commutator and feed terminals being at the other end. The feed may be either from live wires in the conduits, or from trailing wires attached to the locomotor. The motor is maintained in a central position, and in frictional contact with the pipe, by three or more wheels at each end. The wheels are mounted on bell-crank levers, the inner ends of which engage in a collar held in position by a spiral spring or by separate springs. The locomotor may be enclosed in a waterproof case, and may be provided with visible or audible signals. 9 claims.

1898.

6,773. "Improvements in and relating to street lanterns for the reception of incandescent electric lamps." J. E. Stewart. Dated March 21st, 1898. Supporting lamps for street lighting. One or more incandescent lamps are attached by a coupling to a joint piece. This is connected by a bent copper tube with an upright tube in a supporting post, the conductors being passed through these tubes. An opal cover rests on a ring of T-section, carried by three supports on a ring which is bolted to the post. The cover is held under a rubber ring in a cap attached to the joint-piece by a bayonet joint. Ornaments may be applied, such as a band surrounding the ring. The invention is applicable especially in place of gas lamps on existing posts. 1 claim.

6,834. "Improvements in safety devices for use in connection with high tension electric conductors." C. H. Wordingham. Dated March 21st, 1898. Test boxes, in which concentric or other multiple high tension cables are employed, have the conductors of each cable attached to connecting plates which are separated by insulating material. The corresponding plates on the two cables are connected by strips. The plates and the earth connection are surmounted by carbon studs. Levers pivoted carry each at one end a plate, the other end of the levers bearing against studs on the inside of the lid. On the removal of the lid the plates fall and rest on the studs, so as to short-circuit and earth the cables. 3 claims.

6,865. "Improvements in electric conductors and in appliances for making connection with same." J. D. F. Andrews. Dated March 21st, 1898. The wires forming the core of an electric cable are separated by means of insulating material to form two or more separate cores. The ends of the cores to be united are soldered together and a porcelain thimble placed over each. Three forms of cut-out are described in which the fusible wires are embedded in cement or china, and in two of which fine wire bridges are employed which fuse after the main wire. 4 claims.

6,902. "Improved details of electric tramways and railways on a road surface sectional contact system." W. Aldred and G. Carr. Dated March 22nd, 1898. Electric railways and tramways on a road contact sectional conductor system with electro-magnetic switches. Relates to improvements on the switches described in Specification No. 5,391, A.D. 1894, and the collectors, &c. Current is taken from the switch box covers which are made removable with the magnet cores and the necessary contacts attached. These contacts consist of a spring armature and a pair of spring contacts attached to an insulating plate on the underside of the cover. Corresponding contacts are fixed on an insulating base in the box. A number of the contacts are connected in series to the main feeder by a single lead. The circuit to the motor is completed through the armature spring and the lid of the box, when the magnets are excited by a battery circuit from the vehicle through the contacts and springs which are connected to the coils. Similar switch boxes and connections are used for the return only; one contact and spring are dispensed with, as one terminal of the magnet coil is connected to the lid of the box from which the current returns to the battery. The exciting current in alternate vehicles may be caused to flow through the switches in different directions to obviate sticking. The boxes are arranged in two rows parallel with the rails. Long collector bars are carried by vertically sliding bolts in wooded cross bars supported on longitudinal bearers attached to the axle boxes. 5 claims.

6,903. "Improvements in electric plug connectors." A. E. Tanner and G. W. Lowcock. Dated March 22nd, 1898. Relates to a form of coupling in which the insertion of the plug makes contact with certain terminals and a further movement operates a switch to complete the circuit. Within a cast-iron casing formed with bosses for the cables is fitted a porcelain base. On it are secured the fuse terminals, switch arms and spring contacts. The plug is fitted with contact plates which first engage the contacts, then on further movement, the shoulders engage the tappets connected to the switch arm, and so complete the circuit. On removing the plug the shoulders strike the tappets and the springs give a quick break. A cap is carried by the plug and screws on to the boss. Caps may be provided for screwing on the boss when the plug is not in position. 3 claims.

6,944. "A method of and furnace for the continuous melting of glass by electricity." F. H. Becker and L. Sohreyer. Dated March 22nd, 1898. An arc furnace for continuously producing glass is constructed as shown in vertical section. The materials from a hopper pass down a stepped channel under a pair of electrodes at each step, and into a divided receptacle which is heated by arcs between pairs of electrodes at the corners of the furnace. 3 claims.

6,990. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to current and energy meters. Electro-dynamometers, applicable as volt and wattmeters for alternating currents, are constructed as shown by a vertical section of a voltmeter for use on a switch-board. A coil is carried by a vertical shaft in bearings on two bridges which are supported by insulators on two vertical rods carried by lugs screwed to four projections on a lid. The lugs also support two spools wound with the fixed coils of the instrument; in a wattmeter open coils of a thick uninsulated conductor are supported by their end connections only, without spools. The movable coil is connected through two spiral springs with arms on the insulated bridges. The coils are connected with terminals carried by pillars of hard rubber on the lid. In order to prevent the action of light on these, they are covered by caps of opaque material. The shaft also carries a pointer bent down in front of a curved scale and balance weights. Another pointer is carried by a pin in the lid, in line with the shaft and in contact with a friction spring, and can be turned to any desired position by a handle. The lid which carries all these parts, except the scale, is attached to a casing which is attached by side lugs and bolts to the switchboard. The casing has a curved part stiffened by ribs to carry the scale and supports a frame carrying a curved glass front. The casing is provided with a removable bottom plate which supports a cell containing light petroleum oil or other non-viscous liquid; this covers the coils and serves mainly to damp the movements of the coil, rendering the instrument dead beat. Light springs carried by the casing limit the motion of the pointer. 20 claims.

6,991. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Current meters having pivoted coils movable about fixed cylindrical cores between the pole-pieces of permanent magnets, are provided with several improvements in details of construction. The pivots to engage in bearing jewels are supported on the movable coil. Each support is made by turning down the end of an aluminium bar to two smaller diameters drilling the end to receive the pin which is forced into it, screw-threading the smallest part to receive a nut and milling flat sides on the intermediate part to receive a pointer; a thin piece of the end of the bar is then cut off, forming a plate which can be cemented on the coil. The jewels are carried in insulated non-magnetic bridges on the pole-pieces. The nuts secure plates which are bent and split to hold the inner ends of the connecting springs and are soldered to the ends of the coil. The outer ends of the springs are attached to arms on the pole-pieces. The coil is wound on a thin aluminium frame. In order that the air gap between the pole-pieces and cylindrical core may be made very small, the core is grooved, so that the coil can be turned into place upon it without distortion. The core is carried by screws on a non-magnetic plate attached to the magnet. 11 claims.

7,057. "Improvements relating to plug switches and plug connections for the control and distribution of electric currents." H. F. Proctor and J. R. Blaikie. Dated March 23rd, 1898. The socket or tubular part of a plug switch or connection is fitted with a spiral spring or the like which is compressed when the plug is inserted. Adjustment for wear, &c., may be obtained by screwing up end cups or the like. Instead of a spiral spring, an "accordion" folded metal ribbon or stamping may be employed. 3 claims.

7,058. "An improved method of preventing the corrosion of electric battery connections." W. R. Underhill and P. W. Marthey. Dated March 23rd, 1898. Connections, especially those of the screw and nut type, are prevented from corroding by covering the exposed surfaces with a cap of non-corrosive material such as lead-antimony. The cap may be secured in place by various means. 4 claims.

7,129. "An improved means of generating electrical energy." T. Holmes, A. Holmes and G. S. Holmes. Dated March 24th, 1898. In order to utilise the current existing in rivers, streams, and tidal waters, for the purpose of generating electricity, a number of pontoons carrying paddle wheels are moored in the flowing water, and motion is transmitted from the shaft to the dynamo by means of a spur wheel and pinion, toothed gearing and a belt. The current is directed towards the floats of the wheels by plates, and the races between the pontoons are provided with bottom plates. Instead of paddle wheels, an endless chain or chains carrying floats or buckets may be employed. 1 claim.

7,199. "Improved wall socket and plug for electrical fittings." L. G. Tate. Dated March 24th, 1898. Relates to a wall socket and plug. The base of the socket is formed with a central raised bridge or partition which separates the metallic connections. These are fitted with binding-screws for the leading-in wires, and with a socket for the split pins of the plug. The cover is suitably perforated, and is screwed to the bridge. The plug is also fitted with a partition and cover, holes being drilled for the passage of the conducting wires. 2 claims.

7,283. "Improvements in miners' lamps, and apparatus for electrically lighting the same." S. Harrison. Dated March 25th, 1898. Relates to apparatus for electrically lighting these. A gastight box containing the accumulators and induction coil, has a recess into which the base of the lamp fits. An ebonite disc rests on springs which complete the primary circuit, through terminal contacts, when the lamp is inserted into the recess. The secondary circuit wires from the induction coil are connected to the stud and to the spring respectively. A guide or staple is provided, so that when the lamp is inserted into the recess the insulated contact piece touches the stud, and the primary circuit having been automatically completed, a spark passes from the bridge piece to the wick, which contains copper wire strands. The return current passes through the body of the lamp, and thence to the induction coil through the spring contact. The lower part of the wick is covered with an insulating tube. The provisional specification mentions the use of a current from a high tension dynamo, the use of a wick provided with copper foil, and a platinum wire terminal fused in the glass in the case of a glass lamp. 3 claims.

7,333. "Improvements in the construction of plates for electrical accumulators or storage batteries." E. Merian. Dated March 26th, 1898. The electrode is made up of two or more plates with projecting horizontal strips, which are held together by little projections, and are soldered together. Raised edgings or ribs are formed on the plates, and holes are made through them. Each part of the plate may be made by casting, cores of plastic material representing the active material being used in the mould, and this plastic material is subsequently removed by the action of water. 4 claims.

7,367. "Improvements in or relating to electric indicators or annunciators." A. J. Boult. (The Antwerp Telephone and Electrical Works.) Dated March 26th, 1898. An indicator for telephone stations, &c., consists of a core with two coils and two pivoted armatures, the whole being carried in a suitable casing. The coil is in the subscriber's circuit, the effect of a call being to attract the armature, an ebonite block on an arm on the armature causing a local battery circuit to be completed through contacts. This circuit includes the coil, causing the core to be further energised to attract the armature towards a projection on the core, raising a flap to disclose a number on the piece. The armature also completes a night call or indicator circuit by bringing a rod into contact with a second rod. The local circuit is broken by the operator to restore the parts. Projections or screws of gun metal, &c., prevent the armatures from adhering to the core. The contacts are made of long flexible strips, and have a slight relative sliding motion when bent downwards, ensuring the contacts being kept clean. 4 claims.

7,467. "Improved means applicable for use in operating electrically illuminated signs, advertising media, or the like." W. T. Bell. Dated March 28th, 1898. Incandescent lamps, arranged on an advertisement or sign board, are lighted to represent the advertisement or sign. The drum, which is preferably of rectangular section and is provided with conducting face-plates, is covered with jacquard cards arranged on a flexible carrier. The drum is reciprocated by means of a cam towards and from spring contact bars, connected with the lamp wires, and thus certain lamps determined by the jacquard will be lighted while the front plate of the drum abuts against the contacts. On withdrawing the drum from the contacts, it is rotated to a quarter turn to bring the next face into operation. To prevent sparking, a cut-out is used which breaks the circuit slightly before the retreat of the cylinder from the contacts. This consists of a disc or cam of non-conducting material, provided with flanges, on which are mounted rings, placed in metallic connection with one another by a strip. Brushes of the main circuit make contact with these rings, and, one ring being formed with a gap, the circuit is thus broken. 6 claims.

7,471. "Improvements in electrolysis." W. L. Wise. (Solway & Co.) Dated March 28th, 1898. For the purpose of obtaining the maximum output in the electrolysis of an alkaline chloride by means of a mercury cathode, the electrolyte is composed of two layers. The lower one, of great density, lies on the mercury and is practically free from chlorine. The upper one, of small density, lies on the former layer, contains the anode or anodes, and becomes saturated with chlorine. 1 claim.

7,583. "Improvements in and connected with electrical switches." H. C. E. Jacoby and White, Jacoby & Co., Limited. Dated March 29th, 1898. Relates to switches for controlling electrically-operated lifts, &c. A shaft is rocked by a rope and pulley or other suitable means, and, in turn, directly operates the reversing switch, and through an eccentric connecting rod and other gearing the arm of the resistance switch. The arm thus always moves in the same direction from the starting point. The connecting rod is fixed to a pulley loose on the shaft. The pulley is connected by a cord on which is a weight with the pulley fast on the shaft. The switch arm is also carried by the shaft. To prevent too rapid a movement of the shaft arm a checking device is employed. In one arrangement this consists of a pendulum rocked by an eccentric carried on a shaft driven by gearing. The wheel is loose on the shaft, and carries a pawl engaging with a ratchet wheel connected to the pulley by a pin having a certain amount of play in a slot. The ratchet wheel is thus driven by a pulley after it has moved through a certain space. Lugs are fitted on the pulleys, so that, when the loose pulley is moved back, it also carries back the fast pulley without actuating the checking mechanism. 2 claims.

7,751. "Improvements in lifts worked by electricity, with hydraulic braking apparatus." La Societe Guyenet et de Mecomble. Dated March 31st, 1898. (Date claimed under Patent, &c., Act, 1883, Section 103, November 12th, 1897, being date of application in France.) Relates to electric lifts in which the descent of the cage under gravity is controlled hydraulically. The usual handing-rope operates a lever pivoted and connected by an arm and link to the starting-switch. A parallel bar with a rolling weight is fitted below the lever. When the lever is in the at-rest position the weight is near the pivot, so that, when the handing-rope is acted on sufficiently to lower the lever below the horizontal position, the weight rolls forward and completes the second position, the time being regulated by a dash-pot. When the lever is raised to the third position, it raises a valve to allow the water to escape from the cylinder, the ram of which is connected to the cage. The descent under gravity is thus controlled. 1 claim.

7,760. "Improvements in and relating to protecting shields for incandescent electric lamps and the like." J. Dewar. Dated March 31st, 1898. Lamps used in ships' passages or elsewhere are each provided with two or more segmental guards constructed to fit together and enclose the lamp. Each segment is provided with one or two projections and supported by a pin on the base plate. Springs and screws are provided to hold the segments up or down. The inner surfaces of the segments are enamelled or painted white, to serve as reflectors when the segments are raised. 3 claims.